GA 1.13:EMD-82-8

BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Electric Power: Contemporary Issues And The Federal Role In Oversight And Regulation

COMPLETED

75

Electric power will play an important role in the Nation's energy picture, but rapidly increasing fuel prices, lower growth rates, and difficulties in developing large powerplants have made it difficult for electric utilities to provide adequate supplies of power at prices the public is willing to pay.

This report provides the Congress with a discussion of

- --important issues in electric power regulation and management,
- --recent GAO reports on some of those issues, and
- --questions and observations about power system planning and development which deserve Federal attention.

It specifically highlights important electric power issues which transcend State, regional, and utility decisionmaking and identifies for the Congress significant areas which should be considered when making decisions affecting the electric power industry.

EMD-82-8
DECEMBER 21, 1981

Request for copies of GAO reports should be sent to:

U.S. General Accounting Office
Document Handling and Information
Services Facility
P.O. Box 6015
Gaithersburg, Md. 20760

Telephone (202) 275-6241

The first five copies of individual reports are free of charge. Additional copies of bound audit reports are $3.25 each. Additional copies of unbound report (i.e., letter reports) and most other publications are $1.00 each. There will be a 25% discount on all orders for 100 or more copies mailed to a single address. Sales orders must be prepaid on a cash, check, or money order basis. Check should be made out to the "Superintendent of Documents".

I

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

B-204689

To the President of the Senate and the
Speaker of the House of Representatives

This report is designed to highlight those issues and observations which should be addressed by the Federal Government when making decisions affecting the electric power industry. This report can assist the Congress and the Federal agencies having oversight and regulatory responsibilities in better understanding the issues and problems facing the industry and the Federal Government's role in dealing with the industry in its rapidly changing environment.

We made this review to amplify and synthesize the work GAO has undertaken dealing with many facets of the electric power industry and to identify areas which may deserve further Federal consideration. Since agencies have previously commented on our work, we did not request comments on this report.

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretaries of Energy, and Agriculture; the Chairman, Nuclear Regulatory Commission; the Chairman, Federal Energy Regulatory Commission; and the House and Senate committees and subcommittees having oversight responsibilities for the matters discussed in the report.

Charles A. Bowsher

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

ELECTRIC POWER: CONTEMPORARY
ISSUES AND THE FEDERAL ROLE
IN OVERSIGHT AND REGULATION

D I G E S T

Over the past few years, GAO has reported on many of the issues and problems and has drawn many observations about the Federal Government's programs which affect the electric power industry. In this report, GAO highlights those issues and observations which should be addressed by the Federal Government when making decisions affecting the electric power industry and identifies areas which may deserve further Federal consideration. GAO also believes that this overview of the industry can assist the Congress and Federal agencies in better understanding the issues and problems facing the industry and the Federal Government's role in dealing with the industry in its rapidly changing environment.

The electric power industry is confronted with many issues and problems. Some of these include maintaining a strong financial position, forecasting future power needs, and deciding how best to balance supply and demand under a realm of regulatory requirements at both the Federal and State levels. Remedies to these problems are not easy, but solutions such as diversifying into non-electric related businesses, deregulating the utilities' generation facilities, and implementing new measures to improve their financial status have been proposed. However, as the debates continue on those areas affecting the electric power industry, the Congress, as well as the Federal agencies having regulatory and oversight responsibilities, should place into perspective the industry's diversity and complexity when considering solutions to the problems.

Dependable supplies of reasonably priced electric power are essential to the Nation's economic and social well-being. To power our factories, heat and light our buildings, and run our home appliances, electric utilities presently use about 30 percent of our primary energy resources. Although electric power will be an important part of our energy future, electric utilities and utility regulatory commissions are troubled by many problems and uncertainties. Rapidly increasing oil and gas prices, substantially lower growth rates, and difficulties in siting and financing large generating plants have made it much more difficult for utilities to provide adequate supplies of power at prices the public is willing to pay.

Industrial, commercial, and residential consumers are vitally concerned with the policies of electric utilities and the government agencies which regulate them. Because of the size and longevity of new powerplants, utilities' investment decisions can strongly affect for decades the economic, environmental, and social costs consumers pay for electric power. Utilities' plans and State and Federal regulatory policies also determine how much power will be available for future growth and what kinds of fuel we will depend on to run our generating plants.

Electric utilities are in a unique position to use their management skills and outreach capabilities for putting national energy policies into practice. Utilities can play a significant role in increasing our energy independence, promoting more efficient use of electricity, and commercializing new energy technologies.

The prospects for utility leadership are complicated by certain characteristics of the industry which have a delaying effect. Because they are regulated in a manner which rewards increased sales and puts a premium on reliable service, most utilities have been understandably reluctant to promote electricity conservation, which inhibits sales or to invest in new technologies which might adversely affect system reliability. Many regulatory officials and utility executives believe that traditional practices should be modified to meet the new challenges facing the industry. Evidence that some regulatory commissions and utilities are willing to promote energy conservation and test new generating technologies is encouraging.

TRENDS IN GOVERNMENT REGULATION

State and Federal regulations now affect a wide range of electric utility operations. During the 1960s and 1970s, existing regulatory statutes were supplemented by a series of new laws to (1) protect the environment, (2) promote independence from foreign fuels, (3) improve electric power planning and management, and (4) increase nuclear safety.

Although there is increasing concern about the costs of regulation, it is doubtful that State and Federal lawmakers will completely abandon the basic objectives of recent regulatory legislation. However, it can be expected that the costs and benefits of regulatory requirements will be examined more closely in the future.

Also, there will be increasing pressure on regulatory officials to manage their programs in a more cost-conscious, businesslike manner. Rather than focusing all their attention on new regulations as a solution to existing problems, electric power planners and policymakers would be better advised to determine if current State and Federal regulatory practices are helping (or hindering) utilities solve the major issues facing the industry. Such issues include:

--Are we getting all the power we can from existing resources?

--Do we use electricity wisely and efficiently?

--How can we reduce the costs of building powerplants?

--How can electricity help reduce our dependence on imported oil and gas?

--Should regulations be changed to reduce the time for developing new powerplants?

--What is needed to commercialize new technologies?

--How can we protect against power shortages and surpluses?

--Is there adequate Federal support for State planning and regulation?

--Can utilities secure adequate supplies of investment capital?

--Are Federal programs organized properly and managed effectively?

OBSERVATIONS

GAO has observed certain conditions from its continual reviews of the electric power industry. These observations, although tentative, can provide a basis for further discussion of the Federal Government's decision-making process which affects the electric power industry.

General observations

--Electric power policies cannot be made in a vacuum. Policymakers must consider the role of electricity in an energy panorama where electric power competes for consumers' dollars with other energy supplies such as natural gas and oil, and where new powerplants compete with conservation

investments. Policymakers should also recognize electric service as a costly and complex energy conversion/delivery process which may begin in a uranium or coal mine and end in an electric toaster or an aluminum smelter.

--Each region of the country faces unique problems and opportunities in providing consumers with adequate supplies of affordable electric power. Every region has its own climate, industrial base, energy resources, economic conditions, and consumption patterns. The challenge to utility executives, and State and Federal regulators, is to manage these resources and constraints in a way which will balance electric power supply and demand at the lowest economic, environmental, and social cost to consumers.

--Changing technologies, fuel prices, and consumption patterns suggest that there are numerous plausible scenarios for the Nation's electrical energy future. It is inappropriate for power planners to base all their decisions on any one approach to balancing power supply and demand. Considerable flexibility will be needed to meet the many uncertainties which lie ahead.

Power planning and policymaking

--Many State regulatory officials are dissatisfied with utilities' progress in adapting to the new challenges of electricity management, but they have done little to encourage innovative proposals from the power companies under their jurisdiction. State utility commissions, by giving electric utilities broadened charters with new economic and regulatory incentives, could encourage the utilities to change their plans and policies.

--Energy transport issues are becoming increasingly important to electric power planners and policymakers. The capacity of coal transportation systems and the cost of moving coal from mines to powerplants are illustrative transport issues. Other examples include the adequacy of interties among utilities and between regions or between "power parks" and load centers. Similarly, the safe movement of nuclear fuels and radioactive wastes constitutes an important energy transport issue.

--There is an increasing need for State and local decisionmakers to discuss their options for managing demand growth in open public forums. The passive approach to demand growth that evolved during times of plentiful energy supplies and declining power rates is no longer appropriate. Power consumers are aware that demand growth raises their rates by triggering construction of expensive new powerplants. They also realize that demand growth and resultant rate increases can be encouraged or discouraged by the policies of electric utilities, State regulatory bodies, and economic development commissions. If grass-roots support for State/regional power programs is not developed through earlier and more open public participation in the planning process, mistrust and policy conflicts will continue to deadlock electric power development programs.

Selecting new energy sources

--Because of the energy lost in converting primary fuels to electricity and transmitting the electricity to end users, electric power should not be used when direct consumption of primary fuels or renewable resources can provide more efficient energy service. By the same token, cogeneration and district heating projects should be planned whenever it is efficient and economical to put waste heat into productive use.

--Multibillion-dollar powerplants with long lead times and new generating technologies without proven track records are unlikely to win the approval of consumers already faced with sharply increased power costs and double-digit inflation. For the near term, at least, many power planners will take a conservative approach which emphasizes power pooling with neighboring utilities, conservation and load management programs, and proven generating technologies with reduced construction budgets and shorter lead times.

--There are many good reasons to promptly commercialize cost-effective conservation techniques and renewable energy resources, but few good reasons to delay their use. In some instances, the most serious obstacles to commercialization are institutional--not technological or economic.

Tear Sheet

--If utilities continue to sell electric power at average rates well below the cost of new supplies while oil and natural gas are deregulated to sell at free market prices, electricity could become our most used and most abused (wasted) form of energy. Even if power rates are restructured to show the high costs of increased consumption, other incentives may be needed to reduce the waste of electricity by landlords and factory owners who perceive energy conservation as a low pay-off investment.

--Commercial development of alternative energy sources and conservation techniques may proceed more rapidly than many power planners anticipate. Demand uncertainties, long lead times, price escalations, and high financing costs are making large conventional powerplants less attractive. Alternative energy sources--with their diversity, lower capital requirements, and shorter lead times--may play an important role as early as the 1980s and continue to make greater contributions in the 1990s and beyond.

State and Federal regulation

--Federal agencies should not usurp the traditional State and local electricity management practices. Federal agencies are ill-equipped to solve the specific problems in electricity management encountered by State and local officials. However, they can help local decisionmakers solve their own problems by providing oversight and technical and financial support. Where Federal regulation is necessary, regional, State, and community officials have every right to insist that Federal regulatory programs be managed in a cost-conscious manner.

--Federal attempts to change State and regional power plans will usually fail. Federal participation, when necessary, should be timed to coincide with the development of plans acceptable to local interests.

--The burden of proof for Federal intervention in State/local electric power planning rests upon Federal regulators. Federal regulation of the electric power industry must be justified in terms of advancing national priorities; ensuring reliable supplies of affordable power; and protecting public health and safety, natural resources, and environmental quality as required by law.

Contents

CHAPTER		Page
DIGEST		i
GLOSSARY		
1	INTRODUCTION AND HISTORY	1
	History of the industry	1
	The increased importance of electric utilities	3
	Objectives, scope, and methodology	5
2	THE ELECTRIC POWER INDUSTRY	7
	Profile of the industry	7
	Consumption trends	12
	Fuel requirements for power production	15
	Oversight and regulation	21
3	TRENDS IN GOVERNMENT REGULATION	25
	Regulation at the State level	25
	The "broad brush" of Federal regulation	31
	Regulation likely to continue under increased scrutiny	34
4	ISSUES AND OBSERVATIONS--A GAO PERSPECTIVE	36
	National issues in power management	36
	Are we getting all the power we can from existing resources?	36
	Do we use electricity wisely and efficiently?	37
	How can we reduce the costs of building powerplants?	39
	How can electricity help reduce our dependence on imported oil and gas?	40
	Should regulations be changed to reduce the time for developing new powerplants?	40
	What is needed to commercialize new technologies?	41
	How can we protect against power shortages and surpluses?	43
	Is there adequate Federal support for State planning and regulation?	44
	Can utilities secure adequate supplies of investment capital?	45
	Are Federal programs organized properly and managed effectively?	45
	Observations drawn from recent work	46

CHAPTER		Page
5	AREAS FOR FEDERAL CONSIDERATION IN ELECTRICITY	50
	Need for continuing Federal oversight	51
APPENDIX		
I	Recent electricity-related GAO reports	53

ABBREVIATIONS

APPA	American Public Power Association
BPA	Bonneville Power Administration
Btu	British thermal unit
CWIP	Construction work in progress
DOE	Department of Energy
EEI	Edison Electric Institute
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EPCA	Energy Policy and Conservation Act of 1975
EPRI	Electric Power Research Institute
FEA	Federal Energy Administration
FERC	Federal Energy Regulatory Commission
FPC	Federal Power Commission
GAO	General Accounting Office
kWh	Kilowatt-hour
MHD	Magnetohydrodynamic generation/ magnetohydrodynamics
MMBDOE	Million barrels per day oil equivalent
MW	Megawatts
NARUC	National Association of Regulatory Utility Commissions
NEPA	National Environmental Policy Act of 1969
NERC	National Electric Reliability Council
NRC	Nuclear Regulatory Commission
NRECA	National Rural Electric Cooperative Association
PURPA	Public Utility Regulatory Policies Act of 1978
REA	Rural Electrification Administration
SEC	Securities and Exchange Commission
TVA	Tennessee Valley Authority

GLOSSARY

Alternative energy sources	Generating and generation-displacing options to coal-fired and nuclear electricity generating facilities. Options include conservation, load management, cogeneration, biomass conversion, solar hot water and space heating, wind energy systems, small hydropower projects, geothermal developments, and power-pricing initiatives.
Average cost pricing	1. In an economic context, the dividing of total cost by the number of units sold in the same period to obtain a unit cost and then applying this unit cost directly as a price. 2. In a public utility context, the pricing of the service without regard for the structure of the market, to recover those portions of total costs associated with each service in order to make total revenues equal to total costs.
Baseload	The minimum load in a power system over a given period of time.
Biomass conversion	The process by which plant materials are burned for direct energy use or electrical generation or by which these materials are converted to synthetic natural gas.
Blackout	The disconnection of the source of electricity from all the electrical loads in a certain geographical area brought about by insufficient generation, an emergency-forced outage, or other fault in the generation/transmission/distribution system servicing the area.
Breeder reactor	An advanced concept of conventional nuclear reactors which, in addition to producing power, is able to produce more fuel than it consumes.

British thermal unit (Btu)	The standard unit for measuring quantity of heat energy in the English system. It is the amount of heat energy necessary to raise the temperature of 1 pound of water 1 degree Fahrenheit (3,412 Btus are equal to 1 kilowatt-hour).
Capacity	Maximum power output, expressed in kilowatts or megawatts. Equivalent terms: peak capacity, peak generation, firm peakload, and carrying capability.
Central station (powerplant)	A large powerplant which generates a significant amount of electricity from one location.
Cogeneration	The simultaneous production of electricity and useful heat.
Conservation	Improving the efficiency of energy use; using less energy to produce the same product.
Decentralized generation	Generation from a number of small, widely separated locations.
Demand	In a utility context, the rate at which electric energy is delivered to or by a system, expressed in kilowatts, megawatts, or kilovolt amperes over any designated period.
Demand forecast	Projection of the future demand for electricity (industrial, commercial, and residential loads). Various types of demand forecasting models include trending, econometric, and engineering or end-use.
District heating	The use of waste heat from electrical generation or industrial processes to meet space heating and hot water requirements for residences and commercial buildings.
Electricity planning	Procedures used to develop electricity plans. Procedures include forecasting, analyzing supply/demand options, and public participation.
Electricity plans	Determination of the supply sources (e.g., nuclear, coal, alternatives) and the demand management options

(Electricity plans cont'd)	(conservation, load management, rate reforms) which will balance power supply and demand at some future time.
Energy	The ability to do work; the average power production over a stated interval of time; expressed in kilowatt-hours, average kilowatts, or average megawacts. Equivalent terms: energy capacity, average generation, and firm energy load carrying capaoility.
Fossil fuels	Coal, oil, natural gas, and other fuels originating from fossilized geologic deposits that depend on oxidation for release of energy.
Fuel cells	An electrochemical cell that derives electrical energy directly from the chemical reaction of a fuel and an oxidant on a continous oasis.
Hydropower	A term used to identify a type of generating station, or power, or energy output in which the prime mover is driven by water power.
Interties	Transmission lines between two or more regions for the transfer of energy and capacity.
Investor-owned utility	A utility which is organized under State laws as a corporation for the purpose of earning a profit for its stockholders.
Kilowatt	The electrical unit of power which equals 1,000 watts.
Kilowatt-hour	A basic unit of electrical energy, which equals 1 kilowatt of power applied for 1 hour.
Load	The amount of electric power delivered to a given point on a system.
Load control (direct)	Actively influencing the demand for electrical energy by directly controlling equipment, machinery, or other devices that use electricity.
Load management	Influencing the level and state of the demand for electrical energy

Load management (cont'd)	so that demand conforms to individual present supply situations and long-run objectives and constraints.
Magnetohydrodynamics (MHD)	A process in which the heat energy of a hot fluid is converted directly to electric energy by passing ionized gas through a magnetic field.
Marginal cost pricing	A system of pricing whereby each additional unit of a product is priced equal to the incremental cost of producing that unit or charging a price for all units of a product equal to the incremental cost of producing the last unit.
Megawatt (MW)	The electrical unit of power which equals 1 million watts or 1,000 kilowatts.
Off-peak	A period of relatively low system demand for electrical energy as specified by the supplier, such as in the middle of the night.
Peaking	Operation of generating facilities to meet maximum, instantaneous electrical demands.
Peakload	The maximum electrical load consumed or produced in a stated period of time. It may be the maximum instantaneous load (or the maximum average load) within a designated interval of the stated period of time.
Photovoltaic generation	A method for direct conversion of solar to electrical energy.
Power	The time rate of transferring or transforming energy; for electricity, power is expressed in watts. Power, in contrast to energy, always designates a definite quantity at a given time.
Power pool	Two or more electrical systems interconnected and coordinated to supply power in the most economical manner for their combined load requirements and maintenance programs.
Primary energy	Energy in its original form, such as coal or oil, before it is converted into another energy form, such as electricity.

Rates (electricity)	The prices charged to consumers for using electricity.
Reliability	Generally, the ability of a system to perform a required function under stated conditions for a stated period of time. In a power system, the ability of the system to continue operation while some lines or generators are out of service.
Renewable energy	Power resources that will not run out--such as the sun, the wind, and the ocean tides.
Repowering	The conversion of an existing gas- and oil-fired steam boiler power plant into a combined cycle plant by integrating one or more combustion turbines.
Reserve capacity	Extra generating capacity available to meet unanticipated demands for power or to generate power in the event of loss of generation resulting from scheduled or unscheduled outages of regularly used generating capacity. Reserve capacity provided to meet the latter is also known as forced outage reserve.
Time-of-day pricing (peakload pricing)	Rates imposing higher charges during those periods of the day when the higher costs to the utility are incurred.
Utility (electric)	A regulated company which generates, transmits, or distributes electricity to the consumer.
Weatherization	The addition of insulation, weather stripping, storm windows, or other measures to make buildings more energy efficient.

CHAPTER 1

INTRODUCTION AND HISTORY

Dependable supplies of electricity and reasonable power prices are essential to the Nation's economic and social well-being. Industrial, commercial, and residential consumers are vitally concerned with the policies of electric utilities and the government agencies which regulate them. To produce the electricity which powers our factories and computers, heats and lights our buildings, and runs our home appliances, the electric utility industry consumes about 30 percent of our primary energy resources.

America's appetite for electricity will increase in the future, especially when new applications develop and where electric power from domestic sources proves to be an appropriate and economical substitute for imported oil and gas. Some industry officials project that, by the year 2000, electricity generation could account for almost half of all primary energy resources consumed in the United States. Other analysts argue that the industry may experience little growth in the next 2 decades, because higher electric bills will lead to much more efficient use of existing power supplies. In either case, electric power will be an integral and important component of our energy future.

The utility industry's efforts to provide the power our Nation needs at prices consumers are willing to pay is presently clouded by many problems and uncertainties. Utilities and the government agencies which regulate them are confronted with economic, environmental, and social conditions completely unlike those of the recent past. Rapidly increasing oil and gas prices, substantially lower growth rates, and difficulties in siting and financing large generating plants are challenging the industry's management capabilities.

Over the past few years, we have reported on many of these issues and problems and have drawn many observations about the Federal Government's programs which affect the electric power industry. In this report, GAO highlights those issues and observations which should be addressed by the Federal Government when making decisions affecting the electric power industry. We also believe that this overview of the industry can assist the Congress and Federal agencies in better understanding the issues and problems facing the industry and the Federal Government's role in dealing with the industry in its rapidly changing environment.

HISTORY OF THE INDUSTRY

Until the late 1960s, electric utility operations were characterized by steady demand growth, increasing production efficiencies, and limited public concern or regulatory scrutiny. Electricity generated in large central station powerplants was generally a better buy for the user; its increasing reliability and availability forced the retirement of most competing power sources such

as small hydroplants, industrial generators, and windmills. The only real competition to central station electric power was direct use of plentiful oil and natural gas. During the 1970s, a combination of factors shattered this enviable environment. The electric power industry entered a period of significant and somewhat traumatic change.

Steady growth in a stable regulatory climate

The importance of electricity to the American economy has increased steadily since the development of incandescent lighting a century ago. From its inception and into the 1960s, the industry grew steadily to meet broadening markets and increasing uses for electricity. Electricity growth, to a large extent, corresponded to the Nation's economic growth. With few exceptions, the demand for electrical power increased every year and doubled about every 10 years. The construction of fewer, but larger, generating units resulted in highly centralized power systems, reduced the unit costs of power production, and led to lower electric prices for consumers. Throughout most of its development, the industry was characterized by steady growth in sales and power production, dependable cost estimates and schedules for constructing powerplants, plentiful fuel supplies, and limited public concern for the environmental or social impacts of new facilities.

Regulatory actions--relating to the propriety of power rates, environmental impacts, and other factors--played a modest role in the growth of the industry. For many years productivity growth more than offset expansion costs, and the industry's ability to offer increasingly better service, coupled with stable or lower rates, minimized confrontations with regulators and consumers. The regulatory process faced by electric utilities was a relatively simple one, and the outcome of rate proceedings and reviews of major expansion plans were largely predictable. Controversies over electric power plans and policies were rare. Unfortunately for utilities and consumers alike, these conditions have changed greatly.

A new era of change and uncertainties

In the late 1960s and throughout the 1970s, a series of changes shattered the stability of utility operations. Changing public interests and public reaction to power interruptions focused national attention on the electric power industry. Service reliability became a public issue, as did the environmental costs of generating and transmitting power.

The 1973 oil embargo and subsequent price increases, combined with rapidly escalating construction costs, elongated construction schedules, and the increased public concern about the impacts of large powerplants, have abruptly changed the industry's historical patterns. Retail power rates doubled between 1973 and 1979. Higher consumer prices, economic downturns, and the emergence of a national

conservation ethic slowed growth in electricity demand. Domestic power sales have increased about 3 percent a year since 1973, compared to an 8 percent a year increase from 1950 to 1970. Unanticipated reductions in demand growth left some utilities with excess generating capacity and others facing hostile reviews of their construction plans. Some utilities may face similar problems in the 1980s, when more large, new powerplants are scheduled to come on line.

The 1970s were also characterized by very significant changes in the regulatory climate. State and Federal officials became much more active in asserting the public interest in the management of power resources. It was no longer self-evident that new powerplants should be built to meet utilities' forecasts of future demand growth. Regulatory officials in some cases have begun scrutinizing utility forecasts and requiring new generating plants to be economically justified, environmentally and socially acceptable, and capable of reducing our Nation's dependence on imported fuels.

Concerns about the viability of nuclear energy as a safe and economical source of electricity had been growing for a decade, but the March 1979 accident at the Three Mile Island nuclear plant in Pennsylvania increased the public's awareness of the potential risks of nuclear power. The response of capital markets and new regulatory requirements reflecting these concerns will intensify current cost pressures and could lead to even longer leadtimes for nuclear powerplants.

Because of these and other recent developments, the utility industry has been abruptly moved from a position of generally amicable public relations to one in which many utility officials perceive skeptical public attitudes as a major problem to be overcome. As discussed below, the manner in which electric utilities and the government agencies which regulate them respond to these new conditions is vitally important to the Nation's power consumers.

THE INCREASED IMPORTANCE OF ELECTRIC UTILITIES

The electric power industry has always figured prominently in helping our Nation achieve its energy goals. The energy problems which now confront us make the utilities' role doubly important. Because of the size and longevity of new powerplants, utilities' decisions to build, defer, cancel, or convert generating facilities will strongly affect, for decades, the economic, environmental, and social costs consumers must pay for electric power. Utilities' plans and State and Federal regulatory policies will also determine how much power is available for future growth and what kinds of fuels we will depend on to run our generating plants. Electric utilities are in a unique position to use their management skills and outreach capabilities for putting national energy policies into practice. Utilities can play a significant role in reducing our dependence on imported fuels, promoting more efficient use of electricity, and commercializing new energy technologies.

Displacing imported oil and gas with domestic fuels

Converting existing oil- and gas-fired powerplants to coal or other domestic fuels is an expensive but important challenge facing electric utilities. The electric power industry consumes some 12 percent of our total oil and gas fuels, and powerplant conversions can help reduce our dependence on foreign sources. Utilities will play an important role in meeting this challenge by influencing the nature and timing of fuel conversion projects and new generating plants. They can also help by adopting load management practices which reduce loads met with oil- and gas-fired turbines and shift demand to times when most electricity can be generated by coal or nuclear power.

A recent DOE study identified three additional ways in which electric utilities can help reduce the Nation's dependence on imported fuels: 1/

--Using power from nuclear and coal plants to displace direct residential use of oil and gas.

--Improving or maintaining completion schedules for new coal and nuclear plants.

--Improving the energy efficiency of customers, promoting renewable resources, and taking advantage of decentralized electricity generation.

Conserving electricity

More efficient use of electricity can help lower demands for oil- and gas-fired generation and thus reduce our dependence on petroleum fuels. Conservation, which provides more productive use of existing power resources, is the least expensive and most environmentally benign supply option. Electric utilities can ease their own financial problems, and help consumers reduce their electric bills by:

--Publicizing the need for conservation and conducting industrial, commercial, and residential energy audits which foster voluntary conservation.

--Helping consumers retrofit existing homes and buildings to conserve electricity. Some utilities are making interest-free loans enabling homeowners to insulate their electrically heated homes.

--Revising power rates which encourage increased consumption and shifting to rate structures which give consumers conservation-inducing price signals.

1/U.S. Department of Energy, "Reducing U.S. Oil Vulnerability," 1980.

--Supplying information on conservation techniques and practices, including comparative costs and results, so prospective users can reduce their total energy consumption.

Commercializing new technologies

The development and commercialization of new energy technologies is another area where utilities have an important role to play. Alternative power sources, such as geothermal, cogeneration, and solar, can help displace energy generated by oil- and gas-fired facilities. Presently, such alternative sources account for only a small fraction of the energy used in the United States. However, their long-range potentials are significant. Utility efforts in research, development, and demonstration of alternative energy sources can help commercialize these new technologies and integrate them into existing power grids.

The prospects for utility leadership

Clearly, electric utilities can play a leadership role in helping our Nation achieve some of its most important energy goals. Whether they can promptly fulfill all the promises and responsibilities of that role is still uncertain. The prospects for success are complicated by certain characteristics of the industry which have a delaying effect.

Most utilities and regulatory bodies have traditionally focused on ensuring adequate power supplies and reducing electric rates by developing larger and more efficient powerplants. As regulated monopolies, the investor-owned electric utilities which provide almost 80 percent of the United States' electrical service earn their income from the rates of return they are allowed on invested capital. These utilities have a natural interest in increasing power sales and expanding generating capacity, thereby increasing the size of the investment on which their earnings are based. Because they have been regulated in a manner which rewards increased sales and puts a premium on reliable service, many utilities have been understandably reluctant to promote electricity conservation (which inhibits sales) or to invest in new technologies (which might adversely affect system reliability or provide insufficent power to meet future needs).

Many regulatory officials and utility executives believe that traditional policies should be modified to meet the new challenges facing the industry. Evidence that some regulatory bodies and utilities are now willing to promote conservation and to test new generating technologies is encouraging. Utility managers and regulators are starting to recognize that the serious challenges now facing the industry demand timely, innovative action.

OBJECTIVES, SCOPE, AND METHODOLOGY

We prepared this report to provide the 97th Congress with a discussion of (1) contemporary domestic electric power issues, (2) our prior reports dealing with those issues, and (3) questions and observations about power system planning and management which the Congress and the Federal agencies may wish to study further. We undertook

this review to amplify and synthesize the work we have undertaken dealing with many facets of the electric power industry and to identify areas which may deserve further Federal consideration.

This report is designed to highlight the issues and observations we identified which should be addressed by the Federal Government when making decisions affecting the electric power industry. The report also provides an overview of the industry to assist the Congress and the Federal agencies having oversight and regulatory responsibilities in better understanding the issues and problems facing the industry and the Federal Government's role in dealing with the industry in its rapidly changing environment.

We intentionally focused this report on broad issues common to most electric power systems. The report mentions, but does not dwell on, many additional and more specific problems such as the complexities of nuclear regulation, the effects of fuel transportation policies, and the environmental impacts of new generating technologies. Although they are not discussed in detail in this report, we have done considerable work on many of these problems. (See app. I, which summarizes the broad range of recent GAO reports on electricity-related issues.)

This report summarizes recent developments within the electric power industry. In this report, we have highlighted and compiled the results of recent GAO reports, our ongoing work, and studies made by other energy analysts instead of conducting any new or additional audit work. Documents such as State energy plans, consulting studies, trade periodicals, and reports from Federal agencies and utility associations--together with past and current GAO studies--form the base from which we identified issues and drew our observations. In some cases the issues and observations go beyond those expressed in prior reports. These further issues and observations evolved from a look at our reports, each dealing with a specific electricity topic, but when viewed in total reflect a broader perspective. We also had five energy consultants review and comment on the report. We did not request agency comments since this report contains no recommendations, and the views expressed are generally based on prior reports in which agency comments had already been obtained.

Chapter 2 looks at how the United States produces and consumes electric power. Chapter 2 also describes some specific features of the industry which should be considered in studying the unique challenges that confront it. Chapter 3 summarizes some of the more significant State and Federal actions which have been taken in recent years to regulate electric power planning and management. In chapter 4, we discuss a series of national issues in power management which we have identified as questions of continuing importance for planning future work. Chapter 4 also outlines some observations resulting from our recent reviews. Chapter 5 draws on the four previous chapters to discuss some areas for

CHAPTER 2

THE ELECTRIC POWER INDUSTRY

The electric power business is characterized by diversity. Electric utilities differ widely in their size and service areas, generating facilities, regulatory status, fuel mix, and financial condition. Some utilities, for example, serve multi-State areas with millions of customers; others operate in rural areas with only a few hundred customers. Some utilities are straining to finance new billion-dollar generating plants. Other utilities, with more modest construction programs, are relatively secure financially, but uncertain as to how they will meet future demand growth. Utilities in a few regions of the country rely heavily on oil or gas to produce electricity, while those in other areas largely depend on coal or hydropower.

Although this overview attempts to describe the national power industry in general terms, it should be recognized from the outset that electric utilities differ substantially throughout the country, and there are numerous exceptions to any general scheme for categorizing them. Throughout this report, we will use collective terms such as "electric utilities" and "the electric power industry." While these terms are convenient, they can also be misleading. The industry is not homogeneous; it includes a multitude of diverse, semi-autonomous utilities, each with its own set of opportunities and constraints.

PROFILE OF THE INDUSTRY

To meet the needs of industrial, commercial, and residential power consumers, the Nation's electric utilities consume enormous quantities of fuel and invest billions of dollars in generation, transmission, and distribution systems. The following paragraphs provide background information and describe some significant aspects of utility operations that are important to understanding the industry and how it is regulated.

Utility ownership

Over 3,000 domestic utilities--which vary greatly in size, purpose, and ownership--generate, transmit, or distribute electricity. Utility owners include private investors, Federal agencies, State and local public agencies, and rural cooperatives. The larger investor-owned utilities account for about 80 percent of the electricity produced in the United States. (See table 1.)

Table 1

Electricity Generation by Type of Ownership--1979

Ownership classification	Percent of production
Investor-owned	78.1
Federal agencies	10.5
Public non-Federal	9.0
Cooperatives	2.4
Total	100.0

Source: Edison Electric Institute's Statistical Year Book of the Electric Utility Industry, 1979.

The size of individual utilities varies greatly, with investor-owned utilities and Federal power agencies tending to be relatively large, cooperatives tending to be relatively small, and public utility districts and municipally owned utilities ranging from very large to very small.

The investor-owned systems generally are granted territorial franchises by State or local government agencies. The franchises, in effect, create local monopolies in that a second investor-owned company cannot be franchised in the same territory. As the classification suggests, the investors in the company, i.e., purchasers of the company's debt and equity issues, are the owners. Due to the special nature of electric utility franchises, utility management must be responsive to its customers as well as its owners. Investor-owned utilities function as regulated monopolies for retail trade. They are chartered by States to provide adequate and reliable supplies of electricity, and to maintain reserves in order to deliver power as needed without sudden or widespread outages. The utilities forecast future demands for electricity and, with approval from State and Federal regulators, construct powerplants and transmission facilities to meet those demands.

Federal agencies directly involved in the supply of electrical power include the Tennessee Valley Authority (TVA) and five Federal power marketing agencies which principally market wholesale Federal power generation from hydropower plants operated by the Army Corps of Engineers and the Bureau of Reclamation. The Tennessee Valley Authority is a unique governmental entity which owns and operates generation and transmission facilities and markets power principally to distribution utilities that ultimately provide retail service to end-users. TVA was established in 1933 to develop the resources of the Tennessee River Basin, specifically the development of hydroelectric power. After full

development of the hydroelectric power potential of the basin, TVA developed a power production system which included fossil-fueled and nuclear generating plants. TVA is currently the Nation's largest electric system in terms of installed generating capacity.

Substantial amounts of electricity are also sold by five Federal power marketing agencies which report to the Secretary of Energy. The Bonneville Power Administration (BPA) is the largest of the five. BPA markets power from 33 Federal hydroelectric projects in the Pacific Northwest. The Southwestern and Southeastern Power Administrations market the power produced at Federal reservoir projects in the southwestern and southeastern States, respectively. Finally, the Western Area Power Administration markets power from hydroelectric powerplants built in widely separated areas in the western States, and the Alaska Power Administration markets Federal hydroelectric power in Alaska. The Federal Government maintains oversight responsibility for the planning, development, and overall operation of the power marketing agencies.

Public non-Federal systems numbered about 1,800 in 1980; these included power supply entities which serve towns and cities (municipals), special utility districts, and State authorities. Municipal utilities are the most common. Cooperatives are, for the most part, consumer-owned utilities incorporated under the laws of the States in which they operate. Most of the over 900 rural electric systems are distribution systems, although a few also generate and transmit power to their distribution system members. Public utility systems and consumer cooperatives are generally nonprofit enterprises, owned and controlled by the people they serve.

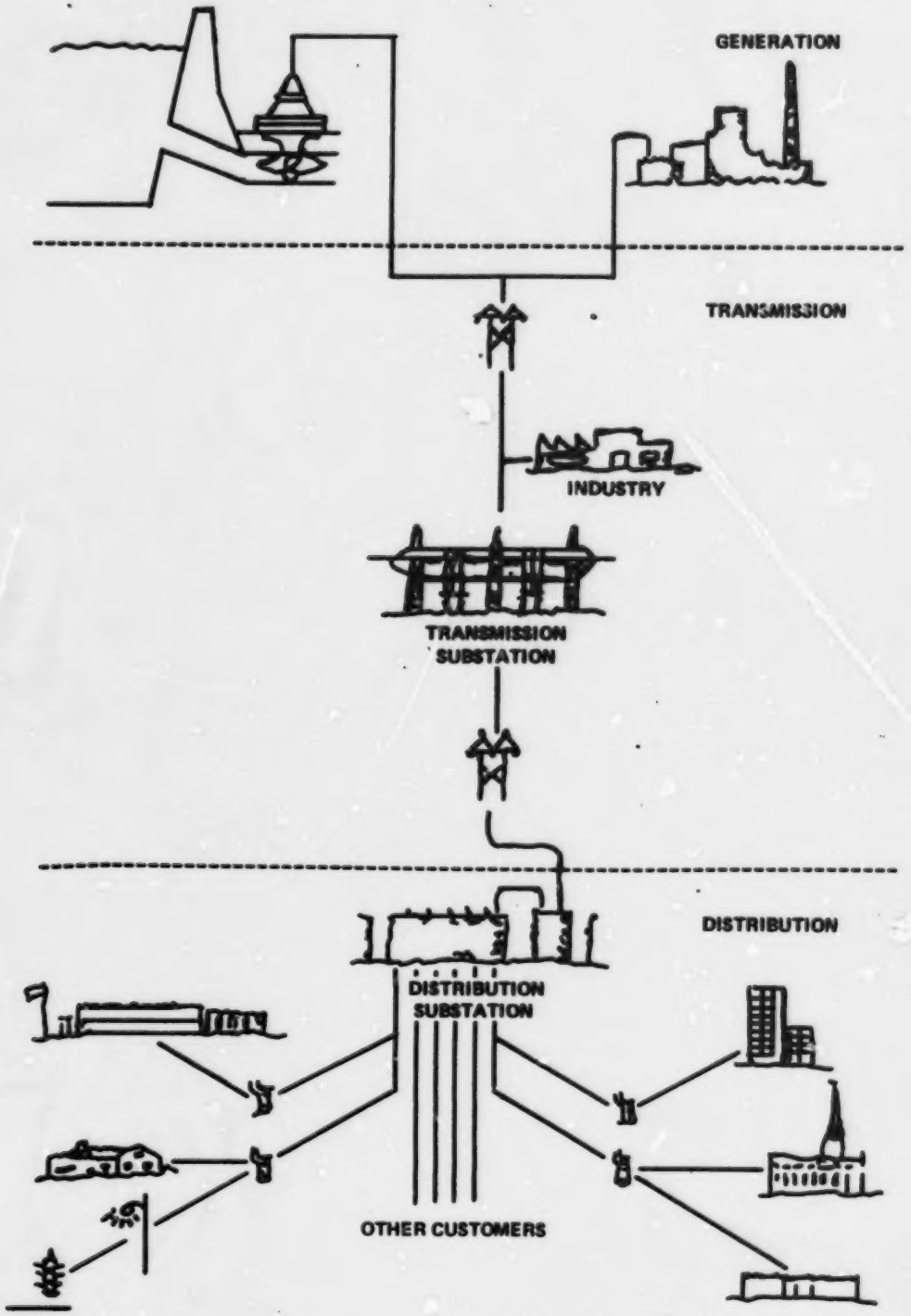
Components of electrical systems

The supply of electric service to ultimate consumers involves three steps: (1) generation of electricity, (2) transmission from the generator to the service area over relatively high-voltage transmission lines, and (3) distribution to individual end-users over relatively low-voltage feeder lines. (See fig. 1.) Although many utilities perform all three steps in the service process, many others do not. Some distribute electricity but do not generate or transmit it. They accomplish this by purchasing generation from other utilities and having the electricity transmitted, or "wheeled," from the source of generation to their service areas. Other utilities are only in the generation and transmission business; they sell electricity to distribution utilities, which ultimately serve end-users.

In addition to operating their own systems, many utilities have joined together to form power pools which permit the transfer of electricity among utilities and between regions. These interconnections are undertaken principally to provide increased economy and reliability in power system operations.

Figure 1

COMPONENTS OF ELECTRIC POWER SYSTEM



Most of America's electric power systems are very reliable under normal operating conditions. However, because the systems are highly centralized and very visible, and depend on key components in remote locations, they are extremely vulnerable to disruptions resulting from war, sabotage, or terrorism. Because the social and economic consequences of major disruptions could be very serious, electrical emergency preparedness needs increased Federal attention. 1/

Capital requirements

The electric power industry is the Nation's most capital intensive industry. Great sums of money are raised each year to finance multibillion-dollar investments in powerplants, transmission lines, and distribution systems. Capital requirements are likely to increase in the future because construction cost escalations are resulting in substantially higher prices for new facilities. A new generating unit to be installed in the mid-1980s, for example, is expected to cost three to four times as much as a similar generating unit installed in the mid-1970s. If its projections are correct, the utility industry will require huge amounts of capital for future expansion. Based on a 1981 report, 2/ electric utilities are projecting a 3.4-percent peak demand average annual growth rate through 1990 and are planning to build about 180,000 megawatts of additional generating capacity. Cost estimates for such construction have approached $400 billion. Several recent studies suggest that some of this capital could be used more productively for investments in energy conservation and increased efficiency.

To meet their capital needs, electric utilities use a combination of debt and equity financing. Those with ambitious construction programs have become frequent customers of the investment bankers and security underwriters. Because of reduced earnings prospects and weakened financial positions, however, there has been a general decline in electric utility stock and bond ratings over the past several years. The common stocks of many utilities are now selling below their book values. The utilities' weakened financial posture has made it more costly to finance new powerplants.

1/U.S. General Accounting Office, "Federal Electrical Emergency Preparedness Is Inadequate," EMD-81-52, May 12, 1981.

2/The National Electric Reliability Council, "Electric Power Supply and Demand 1981-1990 for the Regional Reliability Councils of NERC," July 1981.

CONSUMPTION TRENDS

Between 1950 and 1970, total electricity sales increased steadily at an average rate exceeding 8 percent per year. But after the 1973 oil embargo and subsequent price increases, the demand growth for electricity generally declined to an average of about 3 percent per year. This decline, though partially due to an economic downturn and voluntary conservation, demonstrated that consumer demand for electricity is responsive to price changes. Table 2 shows that demand for electricity grew at a rate of 6.9 percent from 1970 through 1973, but dropped to 2.9 percent as prices rose from 1974 through 1980.

Table 2

Declining Growth Rates for Electric Power Sales

	Customer Groups				
Time period	Residential	Commercial	Industrial	Other	All customers
1950-59	10.7%	9.5%	9.9%	6.1%	9.8%
1960-69	8.7	9.7	5.9	2.5	7.3
1970-73	7.9	8.3	5.3	6.4	6.9
1974-80	3.1	3.3	2.5	3.3	2.9

Source: Energy Information Administration's 1980 Annual Report to the Congress; GAO computations.

Forecasting demand growth for the 1980s and 1990s is one of the most difficult challenges facing the industry. Many factors will shape future consumption patterns, but the most important factor will likely be the price of electric power relative to competing energy sources. As we advised the Congress in our 1977 report on domestic coal prospects, 1/ among all energy sources electricity demand is most sensitive to shifts in relative prices. The Federal Energy Administration (FEA) 2/ estimated that electricity is at least 50 percent more sensitive to such price shifts than natural gas and petroleum products. 3/

1/"U.S. General Accounting Office, U.S. Coal Development--Promises, Uncertainties," EMD-77-43, Sept. 22, 1977.

2/Now a part of the Department of Energy.

3/Federal Energy Administration, "National Energy Outlook." GAO computations.

It is very difficult to forecast future trends in electric power consumption because competing forces are at work. As oil and gas prices are de-regulated, electricity should be favored by consumers because it will appear less costly. State public utility commissions generally establish power rates based on the average costs of owning and operating utility equipment, which includes the inexpensive older generating plants as well as much more costly new ones. This average cost pricing makes increased consumption look less costly than it really is. Such pricing practices are being offset, however, by inflation, higher fuel prices, and escalating construction costs which are driving power rates rapidly upward.

Between September 1979 and September 1980, electric power costs to domestic customers increased by an average of 20 percent. Similar increases are anticipated for 1981. These price increases, coupled with a slowed economic growth and such regulatory pressures for conservation-inducing rate structures such as time-of-day, seasonal, and marginal cost pricing, could extend the current decline in electrical load growth. In August 1980, the Congressional Research Service reported that

> "A recent comparison of electric forecasting models * * * indicated that a 10 percent increase in price would result in a 2.5 percent decline in demand in 1977. By 1990 however, a 10 percent price increase would result in demand decreases ranging between 2.5 percent to more than 10 percent, depending on the model.
>
> * * * * *
>
> "Continued reduction in demand growth is a likely response as customers react to rate increases, and as the utilities continue to institute load management devices, including time-of-use rate structures. The severity of such a reduction is necessarily speculative. Some maintain, however, that electric use at an economically rational level of efficiency would result in a one-third drop in electricity consumption from current levels." 1/

Consumption by sector

As figure 2 shows, residential heating and lighting accounted for about 34 percent of domestic consumption in 1980, while offices

---

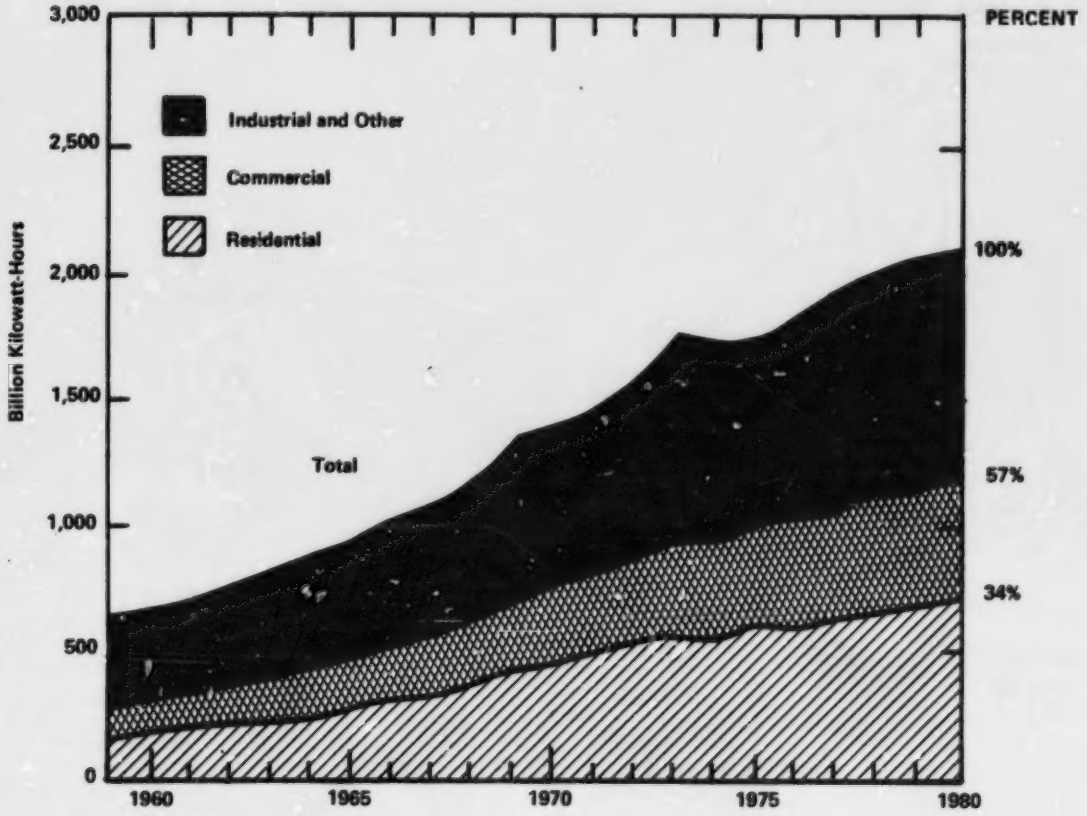
1/"Will the Lights Go On in 1990?" a study prepared at the request of the Subcommittee on Energy and Power, Committee on Interstate and Foreign Commerce, United States House of Representatives, by the Congressional Research Service, Library of Congress (August 1980).

and commercial buildings used about 23 percent. The remaining electricity (about 43 percent) was used mainly for industrial purposes and other uses such as street lighting. These figures reflect a moderate increase over the past 20 years in the percentage of electricity used in the residential and commercial sectors, and a slight decline in the amounts used in the industrial sector.

Figure 2

CONSUMPTION OF ELECTRICITY BY

END USE SECTOR



Source: Energy Information Administration's 1980 Annual Report

In reviewing national statistics such as those shown in figure 2, it is important to remember that consumption patterns vary considerably among regions. In the New England States, for example, only 29 percent of electrical consumption is in the industrial sector, compared to 53 percent in four southern States. 1/ These same southern States use only 14 percent of their electricity in the commercial sector, while the New England region uses twice that much--30 percent--for commercial purposes. Based on industry statistics for 1979, residential usage of electricity within the regions ranges from a low of 32 percent to a high of nearly 38 percent.

FUEL REQUIREMENTS FOR POWER PRODUCTION

To meet America's growing power needs, utilities have used increasing amounts of primary energy--about 24 percent of the United States consumption in 1970 and about 32 percent in 1980. According to recent industry estimates, electric utilities may account for almost half of our total energy consumption by the year 2000. These estimates could prove accurate if (1) the Nation can resume and sustain a strong rate of economic growth, (2) electricty is substituted for petroleum fuels on a large scale, and (3) many new applications are developed for electric power. Such projections are disputed, however, by some energy analysts, who believe that increased power rates and higher electric bills will force many utility customers to reduce their power consumption by conserving electricity and using alternative energy sources, such as gas furnaces, wood stoves, solar hot water heaters, and coal-fired industrial boilers.

In the broadest sense, electric utilities are in the energy conversion/distribution business. They consume such fuels as coal, natural gas, oil, and uranium as their raw materials, convert these fuels into another "carrier" energy form--electricity--and then distribute the electricity to consumers. This conversion and distribution process wastes a great deal of energy. In most thermal powerplants, for example, less than 40 percent of the heat content in the fuel is actually converted to electricity. In addition, transmission losses average about 9 percent of the electricity produced. In the aggregate, due to conversion and transmission losses, only 30 percent of the primary energy consumed by electric utilities actually reaches consumers in the form of electricity. In 1979, for example, the industry consumed 11.2 million barrels of oil equivalent per day (MMBDOE) of primary energy, and produced only 3.3 MMBDOE of electrical energy for consumers. (See table 3.)

1/The four southern States are Kentucky, Tennessee, Alabama, and Mississippi.

Table 3

Conversion and Distribution Losses in Electrical Production - 1979

	Energy (MMBOE)	Percent
Primary energy used to produce electricity: (fossil fuels, nuclear, and other)	11.2	100
Conversion and transmission losses	-7.9	-70
Electricity to consumers	3.3	30

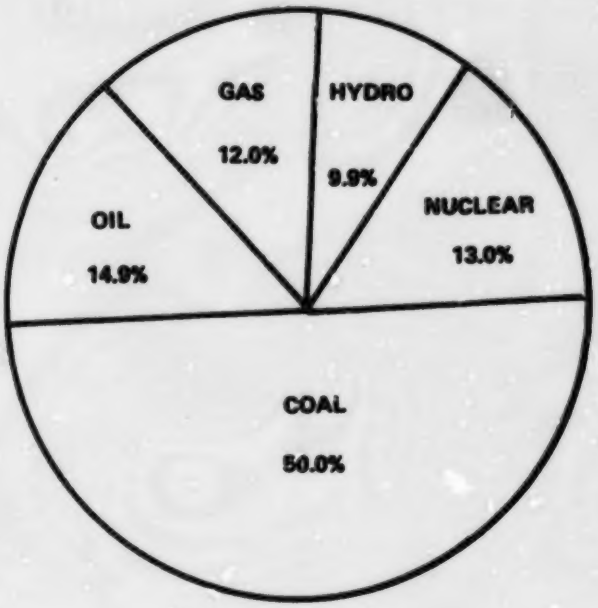
Source: Notice of Public Hearings and Staff Working Paper Public Discussion Package for the 3rd National Energy Plan, Department of Energy.

The mix of fuels used to generate electric power changes over time, principally reflecting the cost and availability of fuels as well as changing technologies. For the past 30 years, coal has been the principal fuel source for electrical generation, accounting for about half of the electricity produced. During the 1960s, the remaining 50 percent was generated from oil, gas, and hydropower. In the early 1970s, the contribution from commercial nuclear powerplants began to grow, and by 1980 nuclear power produced 13 percent of the Nation's electricity (see figure 3).

Figure 3

ELECTRIC GENERATION

BY PRINCIPAL ENERGY SOURCES–1980



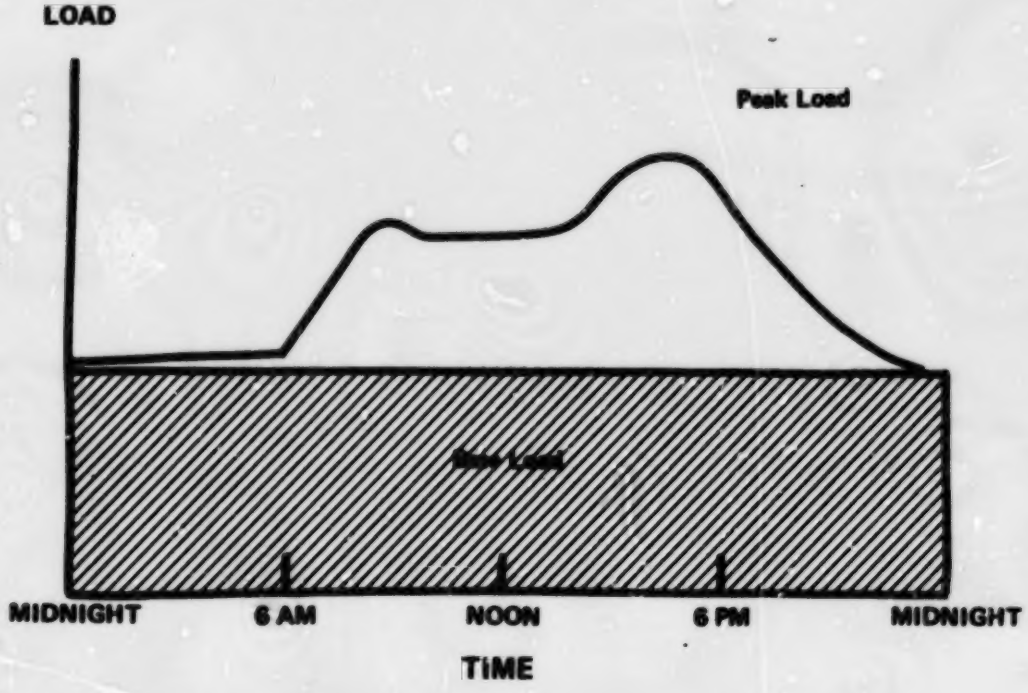
Source: National Electric Reliability Council's 10th Annual Review of Overall Reliability and Adequacy of The North American Bulk Power Systems, August 1980.

In addition, the mix of fuels used to generate electricity varies considerably from region to region. During 1979, for example, about 55 percent of the electricity produced in the New England States was generated from oil, 34 percent from nuclear fuel, and only 5.7 percent from hydropower. In the Pacific Coast States on the other hand, 51 percent of the electricity was generated from hydropower in 1979, about 22 percent from oil, and only 6 percent from nuclear power. These statistics underscore the diverse and regionalized nature of power production and power fuel availability.

Another consideration in fuel usage is the nature of the power loads served. The demand for electricity exhibits significant daily, weekly, and seasonal variations; figure 4 shows a typical summer load profile. The typical summer load is rather

Figure 4

TYPICAL DAILY VARIATION OF SUMMER ELECTRIC LOAD



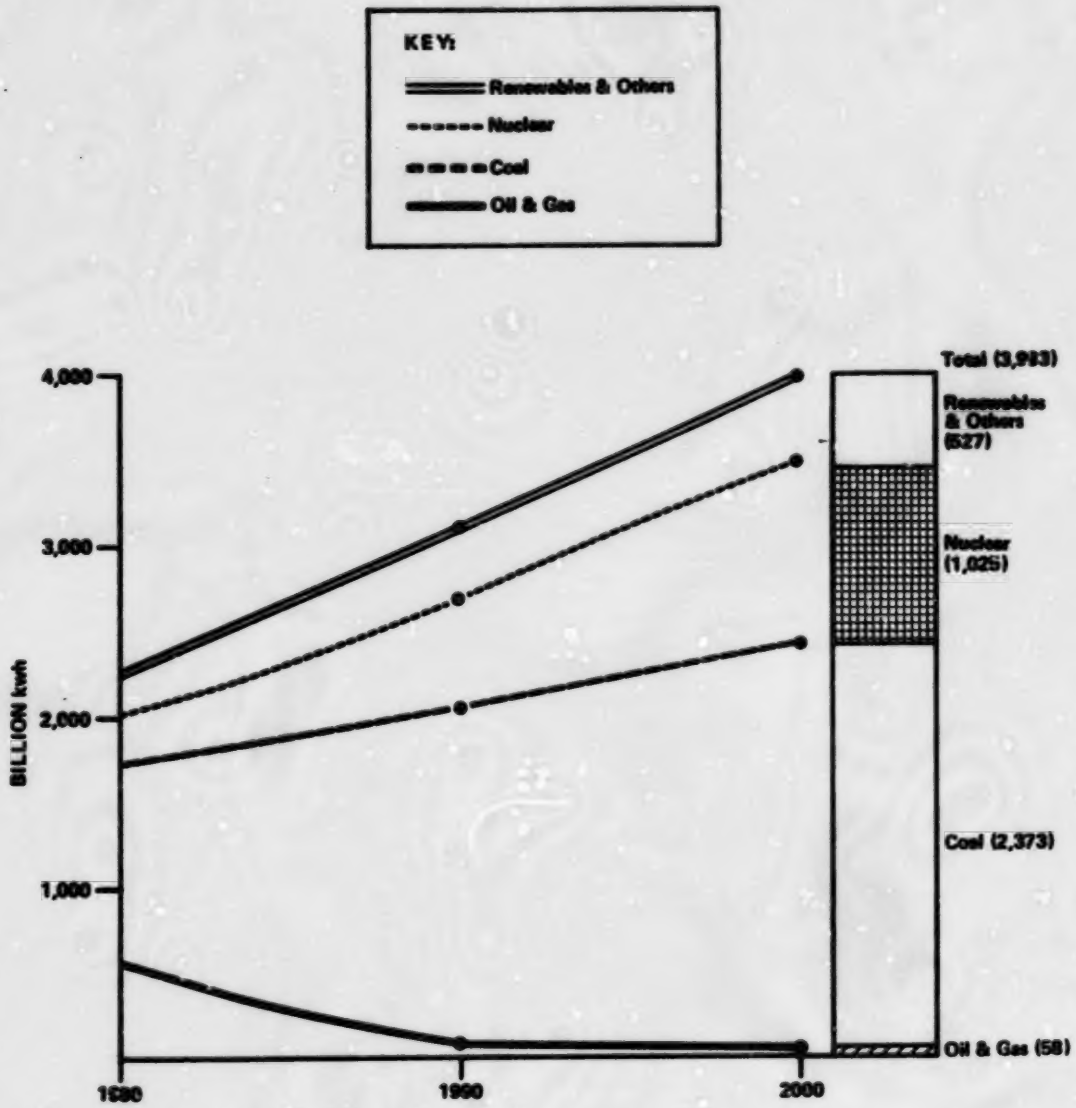
constant overnight but increases as people wake up, switch on appliances, and begin their working day. In the late afternoon, domestic and commercial air conditioning loads increase until a load peak is reached at about 5:00 p.m. The load then decreases as businesses close down and air conditioners and appliances are switched off. The winter load profile is somewhat different, but there is considerable daily variation in all seasons.

To cope with these variations, utilities must plan for a minimum load, which is referred to as the baseload, and for maximum usage levels, or peakloads. Certain types of powerplants are most efficient at producing baseload electricity, while others are better suited for meeting peakloads. Consequently, utilities need a mix of baseload and peaking plants to efficiently satisfy fluctating demands for power. Large nuclear and coal-fired plants designed to operate for several weeks without stopping are generally used to meet baseloads. Oil, gas, and hydro plants designed for rapid start-up and shut-down are more practical for peaking purposes.

No one can predict with certainty what contributions various fuels will make to future power production. For example, State and Federal government policies and decisions can influence the availability of fuels and the cost of developing a particular fuel mix. Coal should remain a major producer and could grow in importance if problems related to strip mining, transportation costs, and air pollution can be resolved. If our national energy goals are achieved, oil and gas--and particularly those supplies imported from overseas--should become steadily less important. The perceived uncertainties surrounding the safety and thus the increased cost of nuclear power make it particularly difficult to predict the impact of this energy source, but the powerplants now under construction should increase the percentage of electricity produced by nuclear energy during the 1980s. While there is considerable hydropower potential in existing nonpower dams and smaller projects, hydropower is unlikely to increase its share of total production. Other renewable generating technologies--such as wind power, biomass combustion, and solar/electric applications--can eventually make very significant contributions, but they are unlikely to be an important source of power during the next 2 decades unless Federal research, development, and demonstration programs are used to accelerate development of cost-effective commercial applications. Figure 5 shows one projection of the principal energy sources for electric generation during the next 20 years.

FIGURE 5

PROJECTIONS OF U.S. ELECTRICITY GENERATION BY FUEL TYPE



SOURCE: ENERGY INFORMATION ADMINISTRATION'S 1980 ANNUAL REPORT TO CONGRESS; GAO COMPUTATIONS

OVERSIGHT AND REGULATION

The electric power industry has formed several associations to oversee and improve its own operations. In addition, the industry is subject to both State and Federal regulation. At the State level, regulatory commissions control retail electricity prices and set power rates at levels which allow utility investors a "reasonable" profit for providing consumers with adequate supplies of power at affordable prices. Some State agencies also have authority to approve sites for generating plants or transmission facilities. Federal agencies regulate various aspects of utility operations, including interstate wholesale power sales, nuclear plant construction and operation, and environmental protection practices.

Industry associations

Within the United States and Canada, the electric power industry has formed nine regional reliability councils to coordinate planning, construction, and operation of bulk power supply systems. (See fig. 6.) Collectively, these nine councils form the National Electric Reliability Council (NERC). NERC was established by the industry in 1968 in response to public concerns about reliable power service. Its primary mission is to promote reliability and adequacy of the bulk power supply for electric utility systems in the United States and parts of Canada.

In addition to NERC, other national organizations have been formed by the industry to conduct research or to provide information on utility operations:

--The Electric Power Research Institute (EPRI) is funded by over 600 electric utilities to develop and manage a technology research program for improving electric power production, distribution, and utilization.

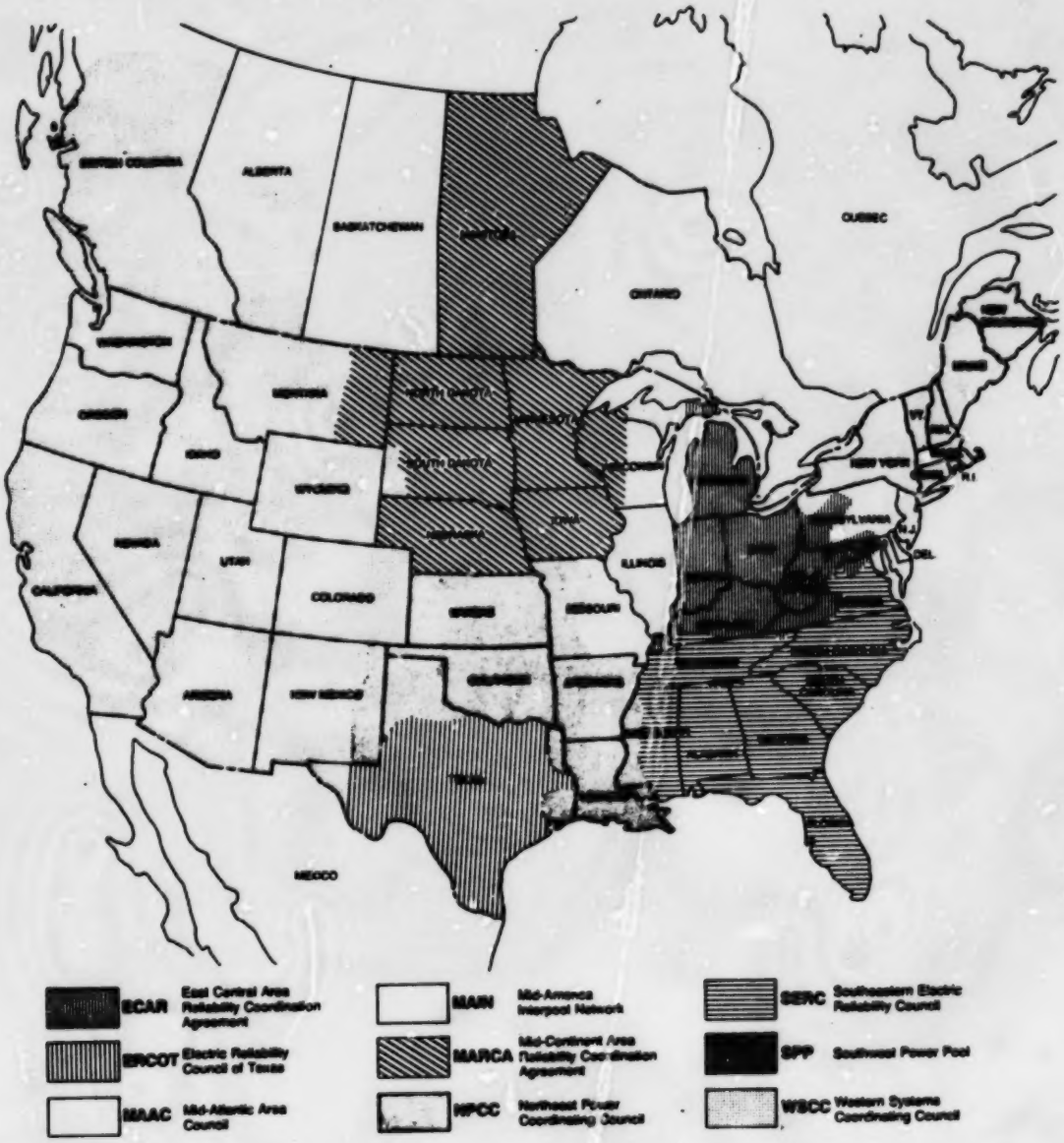
--The Edison Electric Institute (EEI) is an association of investor-owned electric utility companies. EEI gathers information and statistics relating to the electric power industry and makes them available to member companies, the public, and State and Federal agencies. EEI maintains liaison between the industry and the Federal Government and acts as a spokesperson on subjects of national interest.

--The American Public Power Association (APPA) is a national association representing local publicly-owned electric utilities in 48 States, Puerto Rico, Guam, and the Virgin Islands.

--The National Rural Electric Cooperative Association (NRECA), representing rural electric cooperative systems, public power districts, and public utility districts, promotes to bring electrical service to rural America and preserve it for the future.

Figure 6

NATIONAL ELECTRIC RELIABILITY COUNCIL



Source: NERC Annual Report, April 1980.

FURNISHED FROM BEST AVAILABLE COPY

State regulation

States regulate electric utilities by authorizing construction of generating facilities, reviewing and approving future plans, approving sites for powerplants and transmission lines, ensuring reliability and adequacy of service, approving power rates, and setting rates of return on utility investments. Many State regulatory commissions now consider themselves responsible for ensuring (1) realistic electricity demand forecasts, (2) cost-effective conservation programs, (3) development of renewable energy resources, (4) protection of environmental and public health/safety interests, and (5) public participation in electric utility planning and policymaking. On the national level, State regulatory bodies are represented by the National Association of Regulatory Utility Commissions (NARUC).

Federal regulation

Although the primary authority for regulating electric utilities remains with the States, several Federal agencies regulate or influence various aspects of utility operations. From monitoring air quality around coal-fired generating facilities to licensing nuclear powerplants, Federal agencies have been assigned numerous responsibilities which have an impact on power system planning and management.

--The Federal Energy Regulatory Commission (FERC) licenses non-Federal hydroelectric projects and has jurisdiction over the rates charged for electricity sold on a wholesale basis in interstate commerce.

--The Department of Energy (DOE) promotes national energy policies and principles and develops and implements programs designed to ensure adequate and reliable supplies of energy. Specifically, DOE is responsible for assuring the reliability of electric bulk power supply and administering programs in the area of utility system planning, coordination, interconnection, and rate structures. It enforces prohibitions against burning oil or natural gas in new powerplants and fosters the use of coal and other alternatives to imported fuels.

--The Environmental Protection Agency (EPA) establishes and enforces pollution abatement regulations to which utilities must conform.

--The Nuclear Regulatory Commission (NRC) regulates the construction and operation of all nuclear powerplants, regardless of ownership, through a licensing process. Before licensing a new plant, NRC is required to assure there is a valid need for the power and that the proposed nuclear plant is the best alternative for meeting that need.

--The Securities and Exchange Commission (SEC) has jurisdiction over investor-owned electric utilities and holding companies and controls the issuance of securities, consolidations among utilities, and accumulation of assets within utilities.

--The Rural Electrification Administration (REA) in the Department of Agriculture approves requests from rural electric systems for loans and loan guarantees to finance the construction and operation of electrical facilities.

The impacts of these Federal regulatory agencies and their State counterparts are discussed in chapter 3. Chapter 3 also reviews briefly some recent trends in the regulatory climate for electric utilities.

CHAPTER 3

TRENDS IN GOVERNMENT REGULATION

State and Federal regulations now affect a wide range of electric utility operations. During the 1960s and 1970s, existing regulatory statutes were supplemented by a series of new laws to (1) protect the environment, (2) promote independence from foreign fuels, (3) improve electric power planning and management, and (4) increase nuclear safety. Although there is increasing concern about the costs of regulation, it is unlikely that State and Federal lawmakers will completely abandon the basic objectives of recent regulatory legislation. We can expect, however, that the costs and benefits of regulatory requirements will be examined more closely in the future. Also, there will be increasing pressure on regulatory officials to manage their programs in a cost-conscious manner.

Investor-owned electric utilities are granted monopoly franchises by State governments, but must submit to regulation by State utility commissions and several Federal agencies. State regulators approve the siting of all new generating facilities and issue powerplant operating permits. State utility commissions establish investor-owned utilities' rates of return and approve retail power rates. Federal regulatory officials are principally concerned with national and interstate issues, such as nuclear plant safety, power systems reliability, bulk power supply plans, and regional interconnections. Although Federal regulations strongly influence certain aspects of utility operations, primary authority for regulating investor-owned utilities remains with the States. Recent Federal legislation has not altered the charters of State regulatory agencies, but it has assigned both Federal and State agencies important new responsibilities for helping to shape the Nation's energy future.

REGULATION AT THE STATE LEVEL

State regulatory commissions, through their hearing processes and rulings, provide a sense of direction for electric power planners and policymakers. Utility commissions play a leadership role by controlling the prices charged to consumers for electric service, the rates of return allowed on utilities' investments, and the costs included in utilities' rate bases. Utility commissions' rulings and regulations can provide incentives for electric utilities to modify their policies in closer conformance with the priorities expressed by local rate payers, legal authorities, or State and Federal legislators.

State regulatory practices reflect diverse local priorities. Each State is largely autonomous in dealing with its investor-owned utilities and its electric power practices. The regulatory standards and procedures which guide power planning practices in one State may be very different from those used in adjoining

ones. State regulatory bodies vary widely in how they deal with the problems of forecasting demand and developing supply plans, siting and certifying powerplants, providing environmental protection, developing alternative energy sources, and protecting utilities' financial positions. By contrast, public agency utilities, such as public utility districts, are "regulated" only in the sense that they report to local officials. Consequently, within some States, there may be nearly as many regulatory and operating philosophies as there are utilities.

Load forecasting and resource planning

Although there is a trend toward greater State involvement in forecasting future power loads, it is not widespread. 1/ Few States prepare independent forecasts or rigorously scrutinize the forecasts prepared by their utilities. But States which have increased their forecasting capabilities have developed significantly different estimates of future power needs than their utilities. In California, for example, where the State Energy Commission is required by law to prepare an independent demand forecast for comparison to the utilities' forecasts, the Commission has adopted its staff's lower forecasts to avoid perceived weaknesses in the utilities' forecasts. (See fig. 7.) In Oregon, the Energy Facility Siting Council recently adopted a policy enabling it to review energy needs statewide and to determine the amount and type of generating capacity required to meet those needs. The objective of this new policy is to give the Siting Council a more effective role in planning Oregon's future power developments.

Powerplant siting and certification

State utility commissions generally require utilities to meet various licensing and certification requirements before they can construct and operate power-generating and transmission facilities. Matters of regulatory concern often include the need for more power, the location of the facility, its design and operating characteristics, cost estimates, environmental constraints, effects on system reliability, and public health and safety issues. Some States have instituted rather exhaustive certification/licensing procedures, while other States consider facilities construction and operation to be more the responsibility of utility officials.

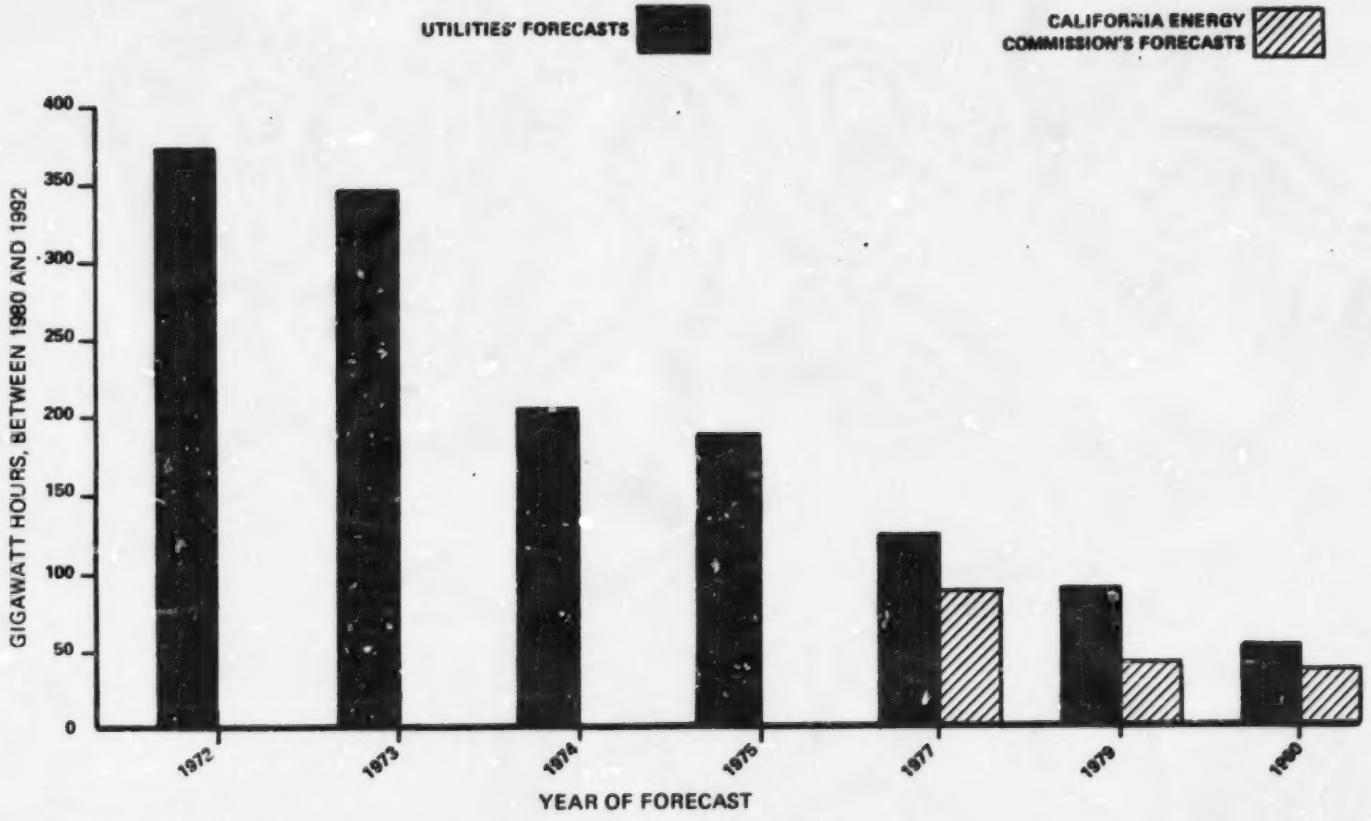
The administrative burdens of siting and certification vary from State to State. In some States, utilities are required to secure licenses and clearances from a host of State and

---

1/We reported on this issue in "Electricity Planning--Today's Improvements Can Alter Tommorrow's Investment Decisions," EMD-80-112, Sept. 30, 1980.

Figure 7

FORECASTED GROWTH IN CALIFORNIA'S SALES
BETWEEN 1980 AND 1992



Source California Energy Commission

local agencies. In other States, the administrative burden is reduced by a "one-stop" program in which one State agency serves as a focal point for powerplant development. In the State of Maryland , for example, the Department of Natural Resources is the focal point for the siting process. The department reviews demand growth for electricity, prepares environmental impact reports, and makes site suitability assessments. With approval of the Public Service Commission, the department acquires suitable sites, which can then be sold to or leased by a utility. Maryland's siting statute is unique in that the State may acquire sites and hold them for future use by electric utilities.

Protecting the environment

States have taken an increasingly active role in administering environmental regulations which have an impact on the siting, construction, and operation of new generating or transmission facilities. Within each State, environmental regulations applicable to electric utilities may be administered by either the utility regulatory commission or the State's environmental agencies. Utilities must comply with the environmental requirements of State laws as well as applicable Federal laws to secure State approval for constructing and operating new power facilities.

Some States have enacted environmental legislation to supplement or strengthen Federal law. This can compound utility problems with the permit and licensing process. Under provision of the Federal Water Pollution Control Act (33 U.S.C. 1251-1376) as amended by the Clean Water Act of 1977 (P.L. 95-217), the Clean Air Act (42 U.S.C. 7401, et seq.) and the Solid Waste Disposal Act (42 U.S.C. 6901-6987), all States were obligated to adopt and enforce minimum standards for protecting the quality of air, water, and land use. But the States can raise their standards above the minimum Federal requirements if they so desire. As a result, many environmental regulations are State specific, and electric utilities are often confronted with different rules and regulations when they serve customers living in two or more States.

Developing alternative energy sources

States vary in their emphasis on alternative energy sources, such as conservation, load management, cogeneration, and renewable resources. Some States are not gathering sufficient information to adequately assess the potential contributions available from these alternatives. Other States have made forceful efforts to encourage their utilities to develop unconventional alternatives. While no States have explicitly discouraged the development of alternative supply sources, most have done little to encourage such developments by providing special regulatory incentives or preferential rates of return for innovative projects.

A few States are taking a leadership role in establishing alternative energy programs. For example, in North Carolina, an alternative energy corporation has been established to engage in energy research, development, and commercialization on a local level. The North Carolina Utilities Commission believed that a merger of public and private interests was needed to promote efficient uses of electricity, reduce future load growth, and develop alternative energy sources. In California, the Public Utility Commission has ordered local utilities to plan for demonstrating and financing solar hot water heaters to reduce electrical demand and promote the use of alternative energy sources. California's Public Utility Commission ranks electricity conservation equally with power supply and considers the effectiveness of utilities' conservation programs when reviewing their rates of return. Figure 8 shows that in California, alternative energy sources may provide a substantial portion of firm capacity by 1992.

Protecting utilities' financial positions

A sound financial position is necessary for utilities to attract the capital needed to construct new facilities and maintain reliable service. State regulatory commissions directly influence the financial integrity of their State's utilities by regulating various aspects of utility operations. Retail power rates, rates of return on investment, and costs which can be included in a utility's rate base are all subject to regulation by State officials.

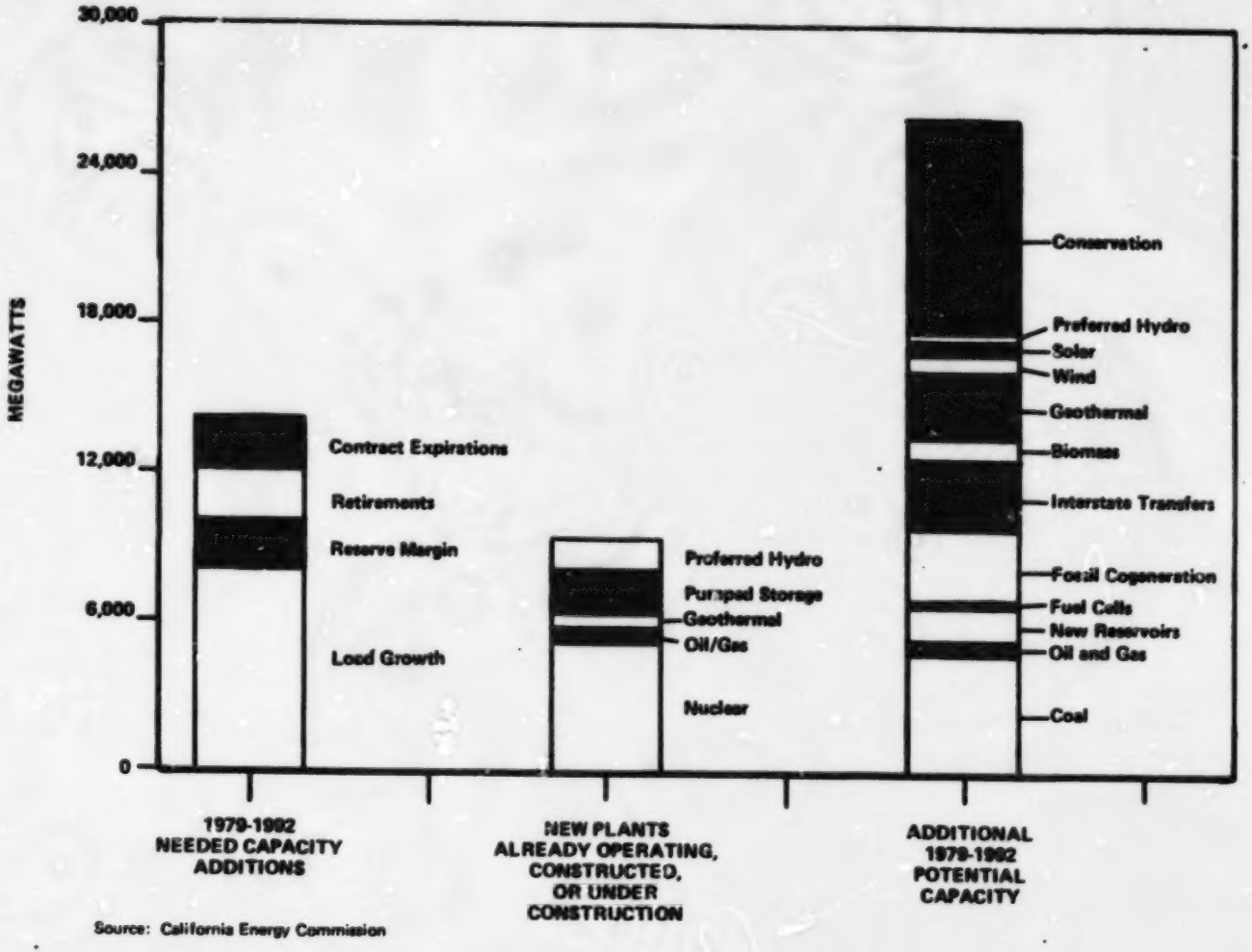
In the recent past, industry representatives frequently complained that State regulators have not adequately protected utilities' financial positions. Some State regulatory commissions have been slow to grant rate increases needed to cover increased costs or may not have provided utilities with a "fair and reasonable" rate of return. Several States do not allow utilities to include construction work in progress (CWIP) in their rate base. 1/ These practices, utilities argue, have driven down the value of utility stock and have made raising money more costly.

New evidence suggests that State regulatory authorities are becoming more sensitive to the financial problems facing many electric utilities. Rate increases for 1980 were more than double the amount received in 1979, and "regulatory lag" decreased significantly. State utility commissions will continue to play a central role in creating incentives which encourage utilities to increase their earnings by providing electric service at the least cost to power consumers.

1/We reported on this issue in "Construction Work in Progress Issue Needs Improved Regulatory Response for Utilities and Consumers," EMD-80-75, June 23, 1980.

Figure 8

ELECTRIC POWER FIRM CAPACITY IN CALIFORNIA FOR 1992



Source: California Energy Commission

THE "BROAD BRUSH" OF FEDERAL REGULATION

Although the utility industry was largely free from Federal regulation during its early years, Federal legislation now affects a wide range of electric utility planning and operating practices. Federal energy and regulatory agencies are active in licensing nuclear powerplants, protecting the environment from power developments, promoting electricity conservation, and improving power planning and policymaking. In addition, the electric utility industry is now required to report to about 50 Federal agencies. In the last 2 decades, Federal regulations have put many new demands on electric utilities long accustomed to virtual freedom from Federal oversight.

Until the 1960s, utility regulation other than for rate-setting purposes was minimal at both Federal and State levels. Decisions on powerplant siting and construction, fuel selection, and transmission practices were generally left to the prerogative of utility officials. Federal regulation was largely centered in the Federal Power Act (16 U.S.C. 791 et. seq. as amended), which authorized the Federal Power Commission (FPC) 1/ to regulate interstate commerce in electricity. FPC policies affected wholesale power sales in interstate commerce, interconnections, wheeling and pooling agreements, and licensing of hydroelectric plants.

The rising tide of regulation

During the 1960s and 1970s, changing public interests and concerns over power interruptions combined to focus national attention on the electric power industry. Electric reliability became a public issue, as did power rates and the environmental costs of generating and transmitting power. The infamous Northeast blackout of 1965 and other interruptions of electric service highlighted the importance of dependable power supplies and raised questions about the adequacy of our energy resources. A 1976 report by the Council on Environmental Quality stated that "energy production and use were perhaps the most important determinants in improving environmental quality* * *conversely, environmental factors are major considerations in judging the acceptability of future energy systems." Public and congressional concerns led to legislation, and regulatory practices were altered to accommodate an increased Federal role in power planning and policymaking. Actions taken at the Federal level spread to the States, and--either independently or as an extension of Federal programs--State commissions, energy offices, health agencies, and other organizations increased their influence on utilities' decisions.

Since the late 1960s, there has been a continuing trend toward increased Federal regulation of utilities in order to (1) protect the environment, (2) reduce dependence on foreign

---

1/Now the Federal Energy Regulatory Commission.

fuels, (3) improve power system planning and management, and (4) promote nuclear safety. A key step in factoring environmental considerations and concerns into utility decisionmaking was the enactment of NEPA--the National Environmental Policy Act of 1969 (42 U.S.C. 4231-4347). NEPA is regarded as the cornerstone of Federal efforts in environmental protection. It requires decisionmakers to take into account the probable effect their actions (such as granting a construction permit or a powerplant license) will have on the environment. From an operational perspective, NEPA's most important provision required the preparation of an environmental impact statement (EIS) for any proposed Federal action significantly affecting environmental quality. Environmental impact statements are required for licensing nuclear plants, hydroelectric plants, and some coal-fired plants. Each EIS must include analyses of the (1) environmental impact of the proposed action, (2) alternatives to the proposed action, and (3) irreversible resource commitments that would result from implementation of the proposal.

Other legislation enacted in the 1970s confirmed the Federal commitment to protecting environmental quality and added new dimensions to utility planning. The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251-1376) marked a turning point in Federal policy toward water pollution by ending the "right to pollute." The amendments were intended to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Their greatest impact on new generating plants has been in the design of cooling systems to control thermal pollution of rivers and lakes. Similarly, the Clean Air Act Amendments of 1977 (42 U.S.C. 7401-7642), which recodified Federal air quality laws, established impediments to the unrestricted discharge of air pollutants from electric powerplants and increased industry attention to the use of pollution control equipment and "cleaner" fuels and combustion processes.

In the early 1970s, an emerging Federal energy policy sought to encourage conservation and to mitigate foreseeable fuel shortages by using persuasion to secure voluntary improvements. In the wake of the 1973-74 Arab oil embargo--which triggered gasoline shortages, increased utility fuel prices, and contributed to an economic recession--Federal energy policy became more forceful and centered on emergency actions to offset the immediate effects of the embargo. These actions included the regulation of some energy supplies, emergency measures to reduce consumption and increase conservation, and accelerated programs to develop additional domestic energy sources. Legislation was also enacted to provide grants, subsidies, and tax relief to accelerate the development of alternative energy sources and to promote energy conservation.

Regulating for long-term solutions

More recent developments indicate that the focus of Federal energy legislation has moved from coping with emergencies such

as the oil embargo to developing a comprehensive, long-term approach to solving our national energy problems. Legislation enacted in the mid to late 1970s provided investment incentives to encourage conservation, production of synthetic fuels, greater use of domestic coal reserves, and development of improved rate structures for electric utilities. In addition, the March 1979 accident at Three Mile Island hightened Federal/State recognition to the need for a more unified regulatory roles. In EPCA--the Energy Policy and Conservation Act (P. L. 94-163)--the Congress enacted its first energy conservation statute by instituting a number of energy conservation measures, including appliance and auto efficiency standards, labeling programs, industrial energy conservation targets, standards for use of recycled oil, and grants for State energy conservation programs and public education. One important purpose of the act, which would have a direct impact on utility decisionmaking, was to reduce the demand for petroleum products, including natural gas, through programs designed to provide greater availability and use of our Nation's abundant coal resources.

The Energy Conservation and Production Act (P. L. 94-385), which amended EPCA, authorizes additional energy conservation measures, including grants for supplemental State energy conservation programs, energy conservation assistance in existing buildings, and weatherization assistance for low-income persons. The National Energy Conservation Policy Act (P. L. 95-619) provides for the regulation of interstate commerce to reduce the growth in demand for energy and to conserve nonrenewable energy resources without inhibiting beneficial economic growth. The act requires that States and certain utilities undertake residential energy conservation programs, authorizes conservation grants to States and nonprofit schools and hospitals, establishes energy efficiency standards for certain products and processes, and sets standards for solar energy and conservation in Federal buildings.

PURPA--the Public Utility Regulatory Policies Act of 1978 (P. L. 95-617)--establishes 11 Federal policy standards for electric utilities to encourage energy conservation, efficient use of facilities and resources, and equitable rates to electric consumers. PURPA also (1) encourages the use of cogeneration and small power production by requiring electric utilities to offer to purchase energy from qualifying cogeneration facilities and small power production facilities at approximately their incremental cost of alternative electric energy; (2) requires a review of the opportunities for energy conservation and increased efficiency through pooling arrangements among electric utilities; and (3) authorizes a study on appropriate levels of reliability, methods of achieving such reliability, and methods of minimizing disruption and economic losses caused by electrical outages.

The Powerplant and Industrial Fuel Use Act of 1978 (P. L. 95-620) further discourages the use of natural gas or oil in

new electric powerplants and promotes the use of coal or such other alternate fuels as shale oil; biomass and municipal, industrial, or agricultural wastes; wood; and geothermal energy sources, petroleum coke, and uranium.

REGULATION LIKELY TO CONTINUE UNDER INCREASED SCRUTINY

The rapid proliferation of State and Federal regulatory requirements has slowed the development of new powerplants and increased the costs of constructing generating and transmission facilities. Within the electric utility industry there is considerable resentment toward what is viewed as a disjointed, costly, and time-consuming regulatory process. Although the utilities' concern about the adverse impacts of regulation is shared by many nonutility spokespersons, other analysts and policymakers point out that effective regulation often has prevented the construction of unneeded or unnecessarily costly facilities. While it is unlikely that State and Federal lawmakers will abandon the basic objectives of recent regulatory legislation, it is likely that the costs and benefits of regulatory requirements will be examined more closely in the future. Also, there will be increasing pressure on regulatory officials to manage their programs in a more cost-conscious and business-like manner.

As the electric power industry entered the 1980s, there was a need felt in the Congress, the administration, and the business community to reexamine the multitude of new regulatory requirements imposed on electric utilities during the last 2 decades. Preliminary evidence suggests that such reexaminations will focus increased attention on the economic effects of Government regulations, overlap and duplication in regulatory requirements, and the costs and benefits of alternative methods of achieving environmental and economic goals.

Although some utilities feel that a much stronger approach is needed to lift the regulatory burdens imposed on them during the 1960s and 1970s, we doubt that State and Federal lawmakers are prepared to turn back the regulatory clock. The economic, environmental, and social impacts of multibillion-dollar electric power projects have become matters of great public interest. In many communities across the Nation, spirited public debates are in progress over the advantages and disadvantages of competing energy investments. It is recognized, for example, that $1.5 billion can buy either (1) a 1,000-megawatt powerplant, which will begin producing electricity in 10 to 15 years, or (2) weatherization for the homes of about 500,000 ratepayers, some of whom can begin saving energy and money immediately. Furthermore, although increased regulation has delayed and added to the costs of power projects, it has also (1) revealed some of the social and environmental costs of power development and (2) saved ratepayers from making premature or inappropriate

investments. As pointed out in one of our reports to the Congress, 1/ there is little evidence to suggest that regulatory delays are causing actual power shortages. While there may be some local exceptions, the Nation's electric generating capacity should be generally adequate through at least 1988.

Rather than focusing their attention on new regulations as a solution to existing problems, we believe that energy planners and policymakers would be better advised to determine if current State and Federal regulatory practices are helping or hindering utilities in solving the major issues facing the electric power industry. A summary and description of such issues--and certain conditions we observed in the course of our work--are provided in chapter 4.

1/"The Effects of Federal Regulation on the Electric Utility Industry," EMD-81-35, Dec. 24, 1980.

CHAPTER 4

ISSUES AND OBSERVATIONS--A GAO PERSPECTIVE

In recent years, we have issued numerous reports dealing with the production, distribution, and consumption of electric power. These reports resulted from reviews undertaken to answer specific congressional requests and to meet other statutory responsibilities of the Comptroller General. Appendix I lists numerous electricity-related reports that we have issued since September 1977.

NATIONAL ISSUES IN POWER MANAGEMENT

In preparing these reports, we identified a number of broad issues facing utility planners and regulatory officials throughout the Nation. We have identified some of these issues as questions of continuing importance which should be addressed by the Congress and the Federal agencies having oversight and regulatory responsibilities when making decisions affecting the electric power industry.

Are we getting all the power we can from existing resources?

Because conventional power-generating facilities are very expensive to build and take many years to complete, power planners are looking for opportunities to increase production from existing facilities. Such efforts take various forms and include repowering fossil-fueled powerplants, installing turbine generators in nonpower dams and waterways, and improving the operation/maintenance of powerplants to increase their output. Other options include: modifying existing reservoirs to store more water for use during high-demand periods; direct load control, which improves the operating efficiency of baseload powerplants; and power pooling among regional utilities or--when adequate interties exist--between regions to share the use of existing generating capacity.

Significant energy supplies can be made available by getting more power from facilities we already have. A consulting study conducted for the State of California showed that 2,800 MW of older, low-efficiency, oil-burning powerplants could be increased to over 8,000 MW by adding generating capacity and increasing overall generating efficiency by about 30 percent. There are also important opportunities to increase hydropower production at existing dam sites. As we reported to the Congress in January 1980, 1/ the Army Corps of Engineers has identified a very significant national potential for developing or increasing hydropower capacity at existing dams. Improved operation and maintenance of power-generating facilities has also been identified as an

---

1/"Hydropower--An Energy Source Whose Time Has Come Again," EMD-80-30, Jan. 11, 1980.

area of significant potential. Our report of May 29, 1979, 1/ showed that one division of the Corps had established a maintenance information system which increased generator availability by 6.2 percent during a 4-year period.

Although there are important opportunities to increase power production from many kinds of existing facilities, it would be a mistake to characterize these opportunities as a trouble-free supply option. As in most aspects of electricity supply and demand, there are many barriers to be overcome before utilities can capitalize on these potential resources. Repowering oil- and gas-fired generating plants may conflict with national goals for reducing our dependence on imported fuels. Installing new generators at existing dams may result in downstream flows which are detrimental to fish and wildlife, recreation, and public safety. Also, the "drawdowns" needed for increased power generation may conflict with regulation of water levels for other purposes. Similarly, new transmission lines and interties to promote the sharing of generating capacity among utilities and between regions are subject to conflicts over environmental impacts, rights-of-way, regulatory jurisdictions, and allocations of costs and savings. It seems clear that hard work, intelligent compromise, and continuing oversight will be needed to achieve more productive use of existing power resources.

Do we use electricity wisely and efficiently?

With conventional powerplants becoming more expensive to build and operate, some utilities and regulatory commissions have turned to electricity conservation as a less costly and more readily available power resource. There are significant potentials for conserving electricity in all regions of the country, although some regions--because of unique power resources and/or consumption patterns--have greater potential than others. Even in regions with similar overall potentials, the mix of conservation opportunities varies because industrial, commercial, and residential consumption patterns are dissimilar.

Much more has been written about conservation of electricity than has yet been done. Inaction has resulted largely from institutional barriers and uncertainties and--to a much lesser degree--from shortfalls in conservation technology. Although much remains to be learned about conservation, many electricity-saving practices and devices are commercially available and relatively simple to use. In the residential sector, electric power can be

---

1/"Increased Productivity Can Lead to Lower Costs of Federal Hydroelectric Plants," FGMSD-79-15, May 29, 1979.

saved by weatherization, 1/ more efficient heaters (water and air) and appliances, and less wasteful use of lighting and hot water. Many of these opportunities, and especially those related to space heating/cooling and electric lighting, are also present in the commercial sector. In addition to these readily available options, there are significant, but more complex and costly, conservation opportunities in electric-intensive industrial plants that have not been modernized with commercially available high-efficiency equipment.

There is general agreement within the electric power community that conservation is needed, but no consensus on how much electricity can be saved by conservation. Recent studies by the Council on Environmental Quality and the Harvard University Business School indicate that Americans could consume 20 to 40 percent less electricity and still enjoy the same or even higher standards of living. The benefits of electricity conservation are now being recognized more explicitly in energy plans at State and local levels. The New York State Energy Planning Board, for example, recently developed a set of conservation measures which could save about 3 billion kWh annually by 1994. California State Energy Commission staff members estimated that conservation measures already in place--existing State conservation initiatives and utility programs--will reduce electricity growth by about 15 percent.

Despite its promise, electricity conservation has been slow in gathering momentum. Electric utilities which presently have their financial resources invested in constructing new generating facilities or have unused capacity, have been understandably hesitant to vigorously pursue actions which reduce their sales. Also, many power planners and regulators are reluctant to plan for conservation as a near-term supply source. They believe there is insufficient knowledge of conservation savings and consumer behavior to ensure that conservation can be counted on as a dependable way of meeting electricity demands. Furthermore, even where conservation is agreed upon as a dependable supply source, there can be difficulties in securing investment capital at rates competitive with financing for more conventional power sources. Other questions which will affect consumers' progress in conserving electricity relate to power pricing techniques, which can encourage or discourage conservation, and consumer protection from (1) conservation frauds and substandard installations and (2) indoor air pollution in "energy-tight" buildings.

1/Weatherization includes installing insulation, weather stripping, and storm windows.

How can we reduce the costs of building powerplants?

In recent years, construction cost overruns and costly delays in completing conventional coal-fired and nuclear powerplants have shocked both utilities and consumers. Regulatory requirements and review practices established to protect public health and safety and maintain environmental quality often have become lightning rods for the frustrations and anger of industry officials and ratepayers. State and Federal regulatory officials contend that costly delays and overruns are often caused by design changes during construction, inadequate cost control practices, unrealistic estimating techniques, or intentional slippages to compensate for reduced demand growth. Common sense suggests that some cost escalations and delays are unavoidable, but many improvements can be made in both regulatory practices and construction management.

There is a need to objectively analyze U.S. powerplant construction programs so that we can determine what factors are causing delays and cost overruns and the relative importance of those factors. It may be necessary for policymakers to reassess some difficult trade-offs between economic goals and environmental or social objectives. Timely and constructive compromise on such trade-offs might reduce costs and improve construction schedules without sacrificing important health, safety and environmental safeguards.

Other industrialized nations, such as Japan, France, and West Germany, have been constructing conventional powerplants more efficiently than the United States. Even though these systems are government-owned, other nations' experiences would suggest that we improve our own practices by

--standardizing powerplant designs,

--streamlining the planning/siting process,

--developing more realistic cost estimates and construction schedules,

--improving cost control practices and incentives,

--using special workforces and labor agreements for building powerplants,

--finding less costly methods of protecting the environment and human health/safety, and/or

--minimizing work stoppages for environmental questions or potential health and safety problems.

Better information on these and other options is needed before we can proceed with confidence to reform our regulatory and construction management practices.

How can electricity help reduce our dependence on imported oil and gas?

Conventional wisdom, expressed in the statements of energy experts and documented in numerous periodicals, holds that in future years, electric power generated with plentiful domestic resources (principally coal and uranium) will be used increasingly to reduce our dependance on rapidly depleting petroleum fuels, particularly imported fuels from the Middle East. It is obviously important to reduce our excessive dependence on imported fuels, and to do so promptly. However, the use of electricity for that purpose is a complex matter which deserves more scrutiny than it has received to date. While increased coal and nuclear generation may reduce consumption of petroleum fuels, a recent study by the Nuclear Regulatory Commission suggests that much of the residual oil which could be displaced, particularly by nuclear generation in the New England States, comes from domestic sources in the Gulf of Mexico and from Venezuela and the Caribbean Islands rather than from the Middle East.

More importantly, it must be remembered that the generation of electric power really represents a rather small portion--about 12 percent--of U.S. consumption of oil and gas. If, as many planners assert, electric utilities are to play a major role in displacing imported fuels, their contributions must logically be extended to the transportation sector which accounts for over 50 percent of U.S. oil consumption. To displace the imported oil consumed in transportation with electricity, we would need Federal support for a planned shift to electric automobiles and trucks, and electrified rail and electric mass transit systems. At the present, there is no national commitment to such policies and none appears imminent.

One option more readily available to utilities for reducing oil and gas consumption is load management, which involves a variety of techniques for shifting electric energy use from peak demand times to off-peak hours. In many regions, electricity generated during peak hours is derived from oil- or gas-fired turbines, whereas coal or nuclear power is used to meet off-peak loads. By shifting demands from peak to off-peak periods, load management could help reduce utilities' dependence on oil and gas.

Should regulations be changed to reduce the time for developing new powerplants?

During the 1970s, many electric utilities canceled or delayed their plans for constructing coal-fired or nuclear powerplants. As we reported to the Congress in December 1980, 1/ from 1974

1/"Electric Powerplant Cancellations and Delays," EMD-81-25, Dec. 8, 1980.

through 1978 the Nation's electric utilities canceled plans for 184 electrical generating units and delayed construction on most other new units. Major reasons for cancelations and delays were reduced growth in electricity demand, utilities' financial difficulties, and regulatory complications. Reduced demand growth for electricity has tended to offset utilities' supply reductions, and most regions of the country still have adequate power supplies. According to many industry spokesmen, however, their experience in the 1970s proved that the timely development of new power supplies is virtually impossible under the existing regulatory climate.

Industry representatives contend that the multitude of requirements imposed on electric utilities by State and Federal regulators have a compounding effect similar to a de facto moratorium on new generating plants. Defenders of the existing regulatory structure argue that many powerplants were canceled or delayed because of changing capital markets, deteriorating financial positions, or overly ambitious construction plans that were based on inflated demand forecasts. According to these arguments, utilities shelved or slipped their construction plans for financial reasons or to avoid building excess capacity, not because their plans were stalemated by regulatory requirements.

There is a clear need for independent reviews of how State and Federal regulatory requirements affect electric power projects, both positively and negatively. Such reviews should (1) include appropriate case studies; (2) determine how much time is required for site selection, environmental clearances, and design/construction reviews; and (3) discuss the financial implications of State and Federal regulatory practices. Appropriate recommendations can then be developed to consolidate, strengthen, or streamline regulatory practices where necessary.

What is needed to commercialize new technologies?

The Federal Government, through the Department of Energy and other institutions, have been funding efforts to develop and demonstrate new energy technologies for generating, conserving, or displacing electricity. New or improved means of generating electricity which have been pursued by industry with Federal support include breeder reactors; wind energy systems; solar photovoltaics; fuel cells; small hydropower turbines; municipal, agricultural, and wood waste combustion systems; geothermal stations; and magnetohydrodynamic generation (MHD). Electricity-saving technologies which have received Federal support include energy management systems for commercial buildings, high-efficiency residential electric appliances, and improved designs for electric motors, electric lights, and electric-powered industrial equipment.

In addition, there are other research and development programs which could displace the use of electricity for certain functions. Solar-oriented building designs, for example, could reduce the demands for electric space heating or cooling in residences and offices by displacing electricity with solar energy. Similarly,

solar hot water systems can displace or reduce the need for electric water heaters. In the same manner, buildings designed or retrofitted to optimize the use of natural light require less electric power for indoor lighting during daytime hours. In other cases it may take many years before we know whether new technologies can make a substantial contribution to meeting U.S. electric power needs. MHD is reportedly more than 20 years away from being a commercial technology for using coal to generate electricity. Fuel cells, on the other hand, may be demonstrated in the next few years and could be a major source of domestic energy by the early 21st century.

While many unconventional technologies are in various stages of research and development, some new or improved technologies are commercially available. The availability of a new or improved technology does not guarantee its use. For such commercially available technologies, the questions of principal importance to power planners and policymakers are those dealing with the prospects for implementation on a large scale and their competitiveness with conventional powerplants. Before widespread commercialization can occur, there also must be (1) consumer confidence in the technology, (2) adequate financial support, (3) a constructive regulatory climate, (4) sufficient industrial capacity, and (5) a labor force of appropriate size and skills for installation and maintenance. While these factors deserve careful consideration before commercialization, Federal guidance will continue to direct the future role of these technologies.

The current administration's philosophy has redirected the outlook for the new technologies' research, development,demonstration, and commercialization programs. Prior Federal policy was to support a variety of energy alternatives in the early stages and continue support through the development stages for technologies that are technically, economically, and environmentally most promising. The proposed redirection of this philosophy is to emphasize long-term, high risk research and development while terminating larger technical demonstrations and commercialization projects. The Administration recognizes that Federal support for energy research is appropriate, but believes large demonstration and the development of commercial applications should be left to the private sector. The difficulties arises particularly as research and development moves toward the high-cost projects needed to demonstrate technical feasibility on a reasonable scale. In many instances, industry may not be willing to underwrite the risks where technology is uncertain and cost-effectiveness in an equally uncertain energy world is not clear. In essence, the issue of how far the Government may want to go in demonstrating commercial feasibility of a particular technology can be influenced by a variety of factors, including not only cost-effectiveness but also

national security concerns and institutional constraints, which private market forces may not be willing or able to respond to in the short term. In summary, what is defined as long-term research and development will be important with respect to fossil research, nuclear, solar, and many other program areas important to utilities. The responses to these circumstances by industry and State and Federal Government will determine how quickly the Nation capitalizes on new technologies for producing, displacing, and saving electric power.

How should we protect against power shortages and surpluses?

Utilities must match generating and non-generating resources to their customers' needs in such a way as to minimize the cost of service. The problem of balancing loads and resources is complicated by the planning horizon for new generating facilities and by the many uncertainties in forecasting future demand.

From site selection and approval, through environmental clearances, plant design, and construction; to commercial operation, large thermal powerplants require leadtimes of 10 to 15 years. It is extremely difficult to accurately predict the demand growth that will develop over these long timespans. Because utilities are charged with providing adequate power supplies and rewarded on the basis of how much they have invested in generating facilities, they are predisposed to overbuild when faced with uncertainty. Utility officials contend that the social and economic costs of generating shortages are high; on the other hand, the costs of unneeded or unnecessarily expensive capacity can also be very significant.

The potential impacts--economic, environmental, and social--of electric power shortages and surpluses are matters of great concern to many people. The powerplant slippages and cancelations of the 1970s are seen by some as precursors of economic stagnation and power brownouts and blackouts in the future. Others view the high reserve margins which presently exist in many regions as excessive and costly insurance against power shortages--insurance for which consumers must pay higher electric bills. Some people are also concerned that the construction of more powerplants to insure against future power shortages will place unnecessary burdens on the environment.

Under these conditions, it is important for power planners and regulators to thoroughly explore methods of improving demand forecasts, and reducing the costs and construction schedules for conventional powerplants. It is also important to look for less costly means of balancing power supply and demand--smaller powerplants that can be built more quickly, power pooling between utilities and regions, conservation-inducing rate structures, and interruptible power sales contracts.

Is there adequate Federal support for State planning and regulation?

Because regulation of electric power development is principally a function of State and local government, regulators at those levels have been challenged by the same problems confronting the utility industry. State regulatory officials and electric utility executives are similarly concerned with the need to

--improve forecasting accuracy,

--conserve electric power,

--improve power pricing and load management practices,

--enhance interties with neighboring power systems,

--restrain the costs of new powerplants,

--develop cogeneration and waste combustion facilities, and

--capitalize on renewable energy resources and plentiful domestic fuels.

One of our reports 1/ showed that most States are not well prepared to deal with these new challenges in a comprehensive manner. Few States have developed sufficient analytical capabilities to thoroughly evaluate utility-prepared demand forecasts. Also, utility-forecasting capabilities could be expanded to use better methods which deal more explicitly with uncertainties, power price increases, and conservation initiatives. States which have taken a closer look at utility forecasts have identified problems and developed different estimates of future power needs. Most of the States, however, continue to rely heavily on utility forecasts and to approve utility investment decisions with minimal scrutiny of forecasting practices and planning assumptions.

Most States lack assurance that the full range of power supply/demand options--particularly alternatives such as conservation, load management, cogeneration, and renewable energy sources--are thoroughly studied and implemented when more cost-effective than conventional nuclear or coal-fired plants. Electric utilities presently have little positive economic or regulatory incentive to promote energy conservation, and solar and other renewable energy options. While many of the States are dissatisfied with utility progress in implementing these options, few States have developed special incentives to encourage greater utility involvement.

1/"Electricity Planning--Today's Improvements Can Alter Tomorrow's Investment Decision" (EMD-80-112; Sept. 30, 1980).

The need for new technical and analytical capabilities has been recognized by some officials in State government, and limited actions are already underway--often with Federal support--to enhance the planning of electric utilities, and to strengthen the evaluative and oversight capabilities of public utility commissions and State energy offices. Effective and timely Federal support could be a continuing need for several years as utilities and regulators work to strengthen their respective planning and management practices.

Can utilities secure adequate supplies of investment capital?

The electric utility industry, because it is so capital intensive, depends on continuing access to large supplies of reasonably priced investment funds. For that reason, it is very important for utilities to secure favorable investment ratings from security analysts and from the financial community. The unsettling changes experienced during the 1970s--especially dramatic cost escalations on new powerplants, coupled with unanticipated declines in demand growth--have prompted the financial community to temper its enthusiasm for utility stocks and bonds. Furthermore, to accommodate consumer interests, many State utility commissions have denied, reduced, or slowed rate increases for their electric utilities. In some States, utilities have been precluded from earning any return on their very large investments in powerplants under construction. (See p. 29.)

Collectively, these factors have reduced the market value of utility securities and have constrained the industry's ability to raise capital. This condition may be a desirable one in that it will encourage utilities to pursue conservation, power pooling, load management, and other options which can balance power supply and demand with reduced capital requirements. On the other hand, a prolonged shortage of capital could preclude the industry from developing the conventional powerplants needed to meet even a moderate level of demand growth. Prolonged capital shortages might also slow the commercialization of alternative technologies supported by Federal research and development programs such as cogeneration projects, wind energy systems, low-head hydroelectric plants, geothermal stations, and waste-fueled powerplants.

Are Federal programs organized properly and managed effectively?

Electricity programs and practices crosscut along a wide range of Federal energy agencies. For example, the responsibilities for nuclear construction and operation, coordination and reliable power supplies, research and development efforts, the issuance of securities, conservation and renewable resource initiatives, and rural electricity distribution can fall under the purview of different Federal entities. Hence, no Federal entity is responsible for coordinating all the electricity issues and its

ramifications. Enlightened leadership and coordination from Federal regulatory agencies, such as DOE, FERC, and the NRC, can help the electric power industry strengthen its planning and management capabilities. The programs and practices of Federal energy agencies can have a considerable impact on how well electric utilities and State regulatory bodies respond to the problems and opportunities which now confront them. Federal regulators should work with State officials and utilities to streamline the regulatory process, ensure continuity and predictability in regulatory reform, and ensure timely actions on power developments and electricity conservation or displacement proposals. In addition, Federal regulators can provide additional encouragement to improve power interties and exchanges between regions to share generating capacity and reduce consumers' power bills.

Federal research and development programs--if appropriately designed, funded, and managed--can provide valuable support for emerging electric technologies and for utility-sponsored demonstrations of conservation, load management, cogeneration, and renewable resources. Leadership in applying national energy priorities to electric utility operations through a showcase approach of Federal programs could be provided by the Tennessee Valley Authority and from DOE's Federal power-marketing agencies.

OBSERVATIONS DRAWN FROM RECENT WORK

In addition to identifying some broad issues in power system planning and management, we have made certain observations from our continual reviews of the electric power industry which will also be considered in planning future detailed reviews and follow-up work. The following observations are tentative; however, we believe they are sufficiently accurate to provide a basis for further discussion of the Federal Government's decisionmaking process which affects the electric power industry.

General observations

--Electric power policies cannot be made in a vacuum. Policymakers must consider the role of electricity in an energy panorama where electric power competes for consumers' dollars with other energy sources, such as natural gas and oil, and where new powerplants compete with conservation investments. Policymakers should also recognize electric service as a costly and complex energy conversion/delivery process which may begin in a uranium or coal mine and end in an electric toaster or an aluminum smelter.

--Each region of the country faces unique problems and opportunities in providing consumers with adequate supplies of affordable electric power. Every region has its own climate, industrial base, energy resources, economic conditions, and consumption patterns. The challenge to utility executives,

and State and Federal regulators, is to manage these resources and constraints in a way that will balance electric power supply and demand at the lowest economic, environmental, and social costs to consumers.

--Changing technologies, fuel prices, and consumption patterns suggest that there are numerous plausible scenarios for the Nation's electrical energy future. It is inappropriate for power planners to base all their decisions on any one approach to balancing power supply and demand. Considerable flexibility will be needed to meet the many uncertainties which lie ahead.

Power planning and policymaking

--Many State regulatory officials are dissatisfied with utilities' progress in adapting to the new challenges of electricity management, but they have done little to encourage innovative proposals from the power companies under their jurisdiction. State utility commissions, by giving electric utilities broadened charters with new economic and regulatory incentives could encourage the utilities to change their plans and policies.

--There is an increasing need for State and local decisionmakers to discuss their options for managing demand growth in open public forums. The passive approach to demand growth that evolved during times of plentiful energy supplies and declining power rates is no longer appropriate. Power consumers are aware that demand growth raises their rates by triggering construction of expensive new powerplants. They also realize that demand growth and resultant rate increases can be encouraged or discouraged by the policies of electric utilities, State regulatory bodies, and economic development commissions. If grass-roots support for State/regional power programs is not encouraged through earlier and more open public participation in the planning process, mistrust and policy conflicts will continue to deadlock electric power development programs.

--Energy transport issues are becoming increasingly important to electric power planners and policymakers. The capacity of coal transportation systems and the costs of moving coal from mines to powerplants are illustrative transport issues. Other examples include the adequacy of interties among utilities and between regions or between "power parks" and load centers. Similarly, the safe movement of nuclear fuels and radioactive wastes constitutes an important energy transport issue.

Selecting new energy sources

--Because of the energy lost in converting primary fuels to electricity and transmitting the electricity to end users,

electric power should not be used when direct consumption of primary fuels or renewable resources can provide more efficient energy service. By the same token, cogeneration and district heating projects should be planned whenever it is efficient and economical to put waste heat into productive use.

--Multibillion-dollar powerplants with long lead times and new generating technologies without proven track records are unlikely to win the approval of consumers already faced with sharply increased power costs and double-digit inflation. For the near term, at least, many power planners will take a conservative approach which emphasizes power pooling with neighboring utilities, conservation and load management programs, and proven generating technologies with reduced construction budgets and shorter lead times.

--There are many good reasons to promptly commercialize cost-effective conservation techniques and renewable energy resources, but few good reasons to delay their use. In some instances, the most serious obstacles to commercialization are institutional--not technical or economic.

--If utilities continue to sell electric power at average rates well below the cost of new supplies while oil and natural gas are deregulated to sell at free market prices, electricity could become our most used and most abused (wasted) form of energy. Even if power rates are restructured to show the high costs of increased consumption, other incentives may be needed to reduce the waste of electricity by landlords and factory owners who perceive energy conservation as a low pay-off investment.

--Commercial development of alternative energy sources and conservation techniques may proceed more rapidly than many power planners anticipate. Demand uncertainties, long lead times, price escalations, and high financing costs are making large conventional powerplants increasingly less attractive. Alternative energy sources--with their diversity, lower capital requirements, and shorter lead times--may play an important role as early as the 1980s and continue to make greater contributions in the 1990s and beyond.

State and Federal regulation

--Federal agencies should not usurp the traditional State and local electricity management practices. Federal agencies are ill-equipped to solve the specific problems in electricity management encountered by State and local officials. However, they can help local decisionmakers solve their own problems by providing oversight and technical and financial support. Where Federal regulation is necessary, regional, State, and community officials have

every right to insist that Federal regulatory programs be managed in a cost-conscious manner.

--Federal attempts to change State and regional power plans will usually fail. Federal participation, when necessary, should be timed to coincide with the development of plans acceptable to local interests.

--The burden of proof for Federal intervention in State/local electric power planning rests upon Federal regulators. Federal regulation of the electric power industry must be justified in terms of advancing national priorities; ensuring reliable supplies of affordable power; and protecting public health and safety, natural resources, and environmental quality as required by law.

--State and Federal regulatory programs will have a pronounced effect on the future role of electric utilities. Enlightened regulatory practices will make it profitable for utilities to be innovative in (1) reducing energy waste, (2) developing new generating technologies, and (3) providing a broadened range of power management services. Less farsighted regulation will convince utilities that electric service has become a "no win" business to be avoided or offset by diversification into other, more profitable activities.

Awareness of these conditions, and continuing attention to the national issues discussed earlier, should provide decisionmakers insight on the effectiveness and efficiency of Federal programs for improving the Nation's electric energy posture. In chapter 5, which follows, we have drawn on the previous chapters to highlight some additional areas for Federal consideration.

CHAPTER 5

AREAS FOR FEDERAL CONSIDERATION ON ELECTRICITY

Federal interactions with the electric power industry usually raise the same question: Why should the Federal Government be involved in power planning and policymaking? After all, it is argued, these are utility functions traditionally regulated by State and local governments. It is also clear that electric power management must have a State and community perspective to accomodate the particular needs of local consumers and to recognize local climates, demographic conditions, and energy resources. These realities suggest that the Federal presence in electric power management, where one is required, should be limited to only what is needed.

Clearly, the Federal Government would be ill advised to usurp the regulatory charters of State governments or to mandate Federal solutions for localized power management problems. Federal interventions in power planning, even if meticulously authorized and conducted, will often conflict with the perceived interests of some utilities and consumers. Why then, cannot the Federal Government simply withdraw and leave electric power development entirely to the utilities and the States? One answer is that timely response to some very important challenges facing the electric power industry could depend on Federal support and oversight. It seems clear, for example, that without Federal support:

--Resource constraints would prevent most State regulatory bodies and many utilities from promptly improving their forecasting capabilities and evaluations of alternative supply/demand strategies.

--Momentum would be lost for interregional power pooling and construction of regional interties to share generating capacity and to capitalize on load diversity between regions.

--Commercialization of emerging electric technologies, such as wind power, solar electric conversion, fuel cells, breeder reactors, waste-fired generators, and more energy-efficient industrial equipment might be seriously delayed or in some cases stopped altogether.

It also seems reasonable that Federal energy officials, because of their long-range, national perspective, should be held accountable for addressing certain electricity issues which transcend decisionmaking processes designed for the State or regional levels. Some of the issues which deserve Federal oversight and may require Federal action involve such questions as:

--Can the U.S. nuclear power industry survive the combined effects of increased public concern over accidents, extraordinary construction delays and cost overruns, and sharply reduced growth in demand for electric power?

--Are Federal transportation policies and rate regulations for coal haulers impeding the development of domestic coal-fired powerplants?

--How can enforcement of economic, environmental, and licensing regulations be managed so as to provide the safeguards intended by law without unreasonably delaying the development of new supply/demand initiatives?

--How can electric utilities finance and develop nonconventional energy sources such as conservation programs and renewable energy projects, which are perceived by some lenders and regulators as higher risks than conventional powerplants?

--To what extent should electric power planning in the United States be coordinated with similar efforts in Canada and Mexico?

--What actions are needed to make our highly centralized power supply systems less vulnerable to sabotage or terrorism?

Finally, and perhaps most importantly, it should be recognized that many aspects of national policy necessitate a continuing dialog between Federal policymakers, State regulators, and electric utility executives. Federal officials need an understanding of utility plans and State regulatory policies to assess national progress in (1) conserving electricity and reducing energy waste, (2) minimizing environmental hazards from power generation and transmission, (3) developing renewable energy resources, and (4) capitalizing on domestic fuels and industrial capacities. Collectively, the plans, policies, and practices of some 3,000 domestic utilities constitute a real-world blueprint of the Nation's electrical energy future which should be reviewed periodically by Federal executives and legislators. Trends and changes in the plans of electric utilities are valuable indicators of where we stand in strengthening the United States' energy posture. Furthermore, the experience and expertise of utility executives and State regulatory officials are important resources which must be brought to bear on the development of realistic and forward-looking energy policies for the Nation.

NEED FOR CONTINUING FEDERAL OVERSIGHT

From the foregoing discussion, it seems obvious that the Federal Government cannot abdicate its responsibilities for overseeing certain aspects of the electric power industry. But Federal regulatory agencies should not be authorized to regulate regional, State, and local power programs unless there is (1) a clear "need to regulate" and (2) a timely regulatory process

which can meet economic, environmental, and social objectives established without unnecessary costs to electric utilities and their customers.

We believe that continued Federal oversight is needed of the Federal regulatory and power marketing agencies in addition to the Department of Energy's research and development functions. The economic and social importance of adequate, affordable power supplies is too great to suggest otherwise. Also, the size and span of the electric power industry is such that Federal oversight is appropriate to ensure that industry plans and State and Federal regulations are consistent with national priorities. We feel that continued Federal oversight is appropriate to ensure that:

--Federal regulation of the electric power industry strikes an appropriate balance between the costs and benefits of regulations and is managed in a cost-conscious and timely manner.

--State and utility efforts to improve forecasting and planning capabilities receive adequate technical and financial support from responsible Federal agencies.

--Adequate progress is made in overcoming technical, financial, and regulatory barriers impeding cost-effective substitution of domestic energy sources for imported oil and gas in electric power generation.

--Transient concerns and preconceptions are not allowed to foreclose any domestic options for producing, conserving, or better managing electric power supplies.

--Interregional planning and power interties are adequate to minimize power shortages and surpluses and to reduce costs to power consumers.

--Federal research and development programs are managed to promote timely commercialization of promising new generating technologies and cost-effective conservation techniques.

--The policies and practices of various Federal energy agencies having an impact on electric power systems are properly coordinated, mutually supportive, and consistent with national priorities.

APPENDIX I

RECENT ELECTRICITY-RELATED

GAO REPORTS

STATE AND REGIONAL POWER PLANNING

1. Region at the Crossroads--The Pacific Northwest Searches for New Sources of Electric Energy. EMD-78-76, August 10, 1978. (236 pp.)

2. Impacts and Implications of the Pacific Northwest Power Bill. EMD-79-105, September 4, 1979. (95 pp.)

3. Electric Energy Development in the Pacific Southwest. EMD-79-73, October 16, 1979. (195 pp.)

4. Electricity Planning--Today's Improvements Can Alter Tomorrow's Investment Decisions. EMD-80-112, September 30, 1980. (173 pp.)

5. Electric Energy Options Hold Great Promise for the Tennessee Valley Authority. EMD-78-31, November 29, 1979. (133 pp.)

6. Continuation of Funding for Montana's Libby Dam Project--Is It Warranted? EMD-80-93, July 10, 1980. (36 pp.)

7. Oil Savings from Greater Intertie Capacity Between the Pacific Northwest and California. EMD-80-100, September 4, 1980. (12 pp.)

8. New England Can Reduce Its Oil Dependence Through Conservation and Renewable Resource Development. EMD-81-58, June 11, 1981. (217 pp.)

NUCLEAR POWER

9. Nuclear Powerplant Licensing: Need for Additional Improvements. EMD-78-29, April 27, 1978. (76 pp.)

10. Areas Around Nuclear Facilities Should Be Better Prepared for Radiological Emergencies. EMD-78-110, March 30, 1979. (78 pp.)

11. Questions on the Future of Nuclear Power: Implications and Tradeoffs. EMD-79-56, May 21, 1979. (27 pp.)

12. Nuclear Power Costs and Subsidies. EMD-79-52, June 13, 1979. (28 pp.)

13. The Nuclear Regulatory Commission: More Aggressive Leadership Needed. EMD-80-17, January 15, 1980. (93 pp.)

14. The Problems of Disposing of Nuclear Low-Level Waste: Where Do We Go From Here? EMD-80-68, March 31, 1980. (30 pp.)

15. Existing Nuclear Sites Can Be Used for New Powerplants and Nuclear Waste Storage. EMD-80-67, April 1, 1980. (25 pp.)

16. Three Mile Island: The Most Studied Nuclear Accident in History. EMD-80-109, September 9, 1980. (72 pp.)

COAL DEVELOPMENT

17. United States Coal Development--Promises, Uncertainties. EMD-77-43, September 22, 1977. (430 pp.)

18. Coal Trespass in the Eastern States--More Federal Oversight Needed. EMD-79-69, May 25, 1979. (43 pp.)

19. Issues Facing the Future of Federal Coal Leasing. EMD-79-47, June 25, 1979. (242 pp.)

20. How to Burn Coal Efficiently and Economically, and Meet Air Pollution Requirements--The Fluidized-Bed Combustion Process. EMD-80-12, December 9, 1979. (45 pp.)

21. Liquefying Coal for Future Energy Needs. EMD-80-84, August 12, 1980. (33 pp.)

22. A Shortfall in Leasing Coal From Federal Lands: What Effect on National Energy Goals. EMD-80-87, August 22, 1980. (103 pp.)

23. Mapping Problems May Undermine Plans for New Federal Coal Leasing. EMD-81-30, December 12, 1980. (58 pp.)

RESEARCH AND DEVELOPMENT

24. Conversion of Urban Waste to Energy: Developing and Introducing Alternate Fuels from Municipal Solid Waste. EMD-79-7, February 28, 1979. (109 pp.)

25. Magnetohydrodynamics: A Promising Technology for Efficiently Generating Electricity from Coal. EMD-80-14, February 11, 1980. (50 pp.)

26. Federal Demonstrations of Solar Heating and Cooling on Commercial Buildings Have Not Been Very Effective. EMD-80-41, April 15, 1980. (36 pp.)

27. Special Care Needed in Selecting Projects for the Alternative Fuels Program. EMD-81-36, December 8, 1980. (15 pp.)

28. Full Development of OTEC's Potential May Be Impeded. EMD-81-62, April 10, 1981. (16 pp.)

29. Fusion--A Possible Option for Solving Long-Term Energy Problems. EMD-79-27, September 28, 1979. (49 pp.)

30. United States Fast Breeder Reactor Program Needs Direction. EMD-80-81, September 22, 1980. (54 pp.)

31. TVA Needs A Written Poliy on the Use of Power System Revenues for RD&D. EMD-81-16, November 25, 1980. (2 pp.)

REGULATION

32. Electric Utility Fuel Procurement Practices and the Impact of Rate Reform Activities on Small Businesses. EMD-79-2, January 19, 1979. (38 pp.)

33. Construction Work in Progress Issue Needs Improved Regulatory Response for Utilities and Consumers. EMD-80-75, June 23, 1980. (78 pp.)

34. Are Hydropower Permits and Licenses Being Issued Quicker Due To FERC's Streamlined Procedures? EMD-81-22, October 24, 1980. (5 pp.)

35. Electric Powerplant Cancellations and Delays. EMD-81-25, December 8, 1980. (33 pp.)

36. The Effects of Federal Regulation on the Electric Utility Industry. EMD-81-35, March 2, 1981. (37 pp.)

37. The DOE Needs to Improve the Timeliness of the Third Annual Reports on Title I of the Public Utility Regulatory Policies Act. EMD-81-56, April 28, 1981. (5 pp.)

38. Federal Electrical Emergency Preparedness Is Inadequate. EMD-81-50, May 4, 1981. (40 pp.)

39. Federal Energy Regulatory Commission's Hydroelectric Permitting and Licensing Efforts Are Being Hampered by Hybrid Applications and Staffing. EMD-81-80, May 26, 1981. (6 pp.)

RURAL ELECTRIFICATION ADMINISTRATION

40. Rural Electrification Administration Loans to Electric Distribution Systems: Policy Changes Needed. CED-80-52, May 30, 1980. (55 pp.)

41. Financing Rural Electric Generating Facilities: A Large and Growing Activity. CED-81-14, November 28, 1980. (140 pp.)

CONSERVATION AND RENEWABLE RESOURCES

42. Commercializing Solar Heating: A National Strategy Needed. EMD-79-19, July 20, 1979. (66 pp.)

43. The Solar in Federal Buildings Demonstration Program. EMD-79-84, August 10, 1979. (16 pp.)

44. Federal Demonstration of Solar Heating and Cooling on Private Residences--Only Limited Success. EMD-79-55, October 9, 1979. (59 pp.)

45. How to Speed Development of Geothermal Energy on Federal Lands. EMD-80-13, October 26, 1979. (44 pp.)

46. Hydropower: An Energy Source Whose Time Has Come Again. EMD-80-30, January 11, 1980. (85 pp.)

47. Geothermal Energy: Obstacles and Uncertainties Impede Its Widespread Use. EMD-80-36, January 18, 1980. (41 pp.)

48. Uncertainties About the Effectiveness of Federal Programs to Make New Buildings More Energy Efficient. EMD-80-32, January 28, 1980. (19 pp.)

49. The Geothermal Loan Guarantee Program: Need for Improvements. EMD-80-26, January 24, 1980. (42 pp.)

50. The 20-Percent Solar Energy Goal--Is There a Plan to Attain It? EMD-80-64, March 31, 1980. (14 pp.)

51. The Rural Energy Initiative Program for Small Hydropower--Is It Working? EMD-80-66, April 1, 1980. (9 pp.)

52. Industrial Cogeneration--What It Is, How It Works, Its Potential. EMD-80-7, April 29, 1980. (182 pp.)

53. Energy Conservation: An Expanding Program Needing More Direction. EMD-80-82, July 24, 1980. (15 pp.)

54. Delays and Uncertain Savings in Program to Promote State Energy Conservation. EMD-80-97, September 2, 1980. (69 pp.)

55. Non-Federal Development of Hydroelectric Resources at Federal Dams--Need to Establish a Clear Federal Policy. EMD-80-122, September 26, 1980. (23 pp.)

56. Management Problems Impede Success of DOE's Solar Energy Projects. EMD-81-80, December 22, 1980. (67 pp.)

57. Electric Utilities Concerns with the Department of Energy's Wind Energy Programs. EMD-81-77, April 21, 1981. (5 pp.)

58. Elimination of Federal Funds for the Herber Project Will Impede Full Development and Use of Hydrothermal Resources. EMD-81-110. June 25, 1981. (16 pp.)

FEDERAL POWER MARKETING AGENCIES

59. Tennessee Valley Authority Can Improve Estimates and Should Reassess Resource Requirements for Nuclear Powerplants. PSAD-79-49, March 22, 1979. (25 pp.)

60. Status of the Tennessee Valley Authority's Load Management Practices. EMD-79-44, April 11, 1979. (5 pp.)

61. Review of Peaking Power Needs in the Pacific Northwest. EMD-80-46, January 4, 1980. (12 pp.)

62. Administrative Feasibility of Two-Tiered Pricing by the Bonneville Power Administration. EMD-80-57, February 6, 1980. (4 pp.)

63. Federal Power Marketing Agencies Could Do More in the Conservation And Renewable Resource Area. EMD-80-65, July 8, 1980. (4 pp.)

64. The TVA Needs To Improve Security and Inventory Controls At Power Sites. EMD-81-60, March 10, 1981. (17 pp.)

65. BPA Efforts in Implementing the Pacific Northwest Power Planning and Conservation Act. EMD-81-67, April 8, 1981. (6 pp.)

66. Policies Governing BPA's Repayment of Federal Investment Needs Revision. EMD-81-94, June 16, 1981. (14 pp.)

(005223)